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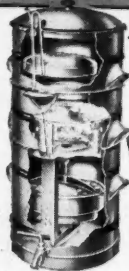
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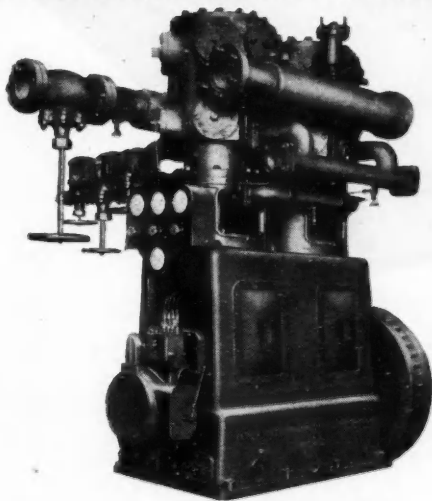
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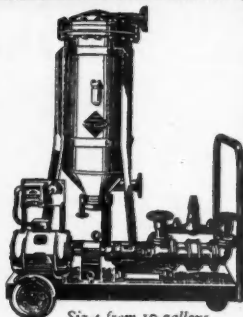
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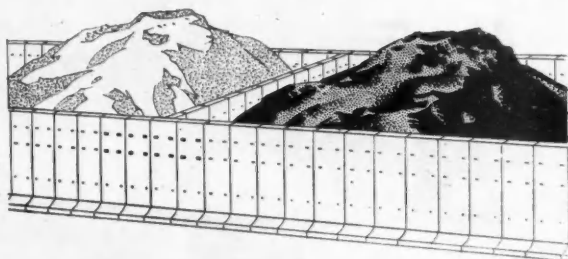
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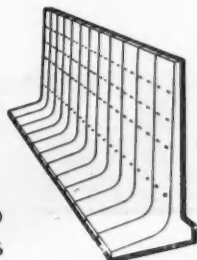
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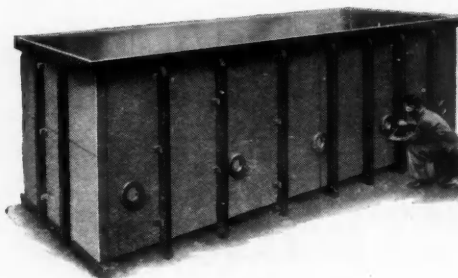
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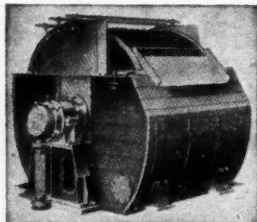


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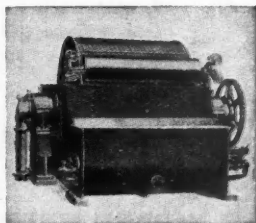
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# The Chemical Age

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## Medical Research and Chemicals

**M**EDICAL Research Council Reports do not now appear annually; the latest, just published (HMSO, 6s. 6d.), covers the period 1948-1950. Like its predecessor (1945-48), the new Report selects some of the main trends in medical research for broad commentary and in this section chemical aspects of progress are well to the fore, not surprisingly so in this age of antibiotics, cortisone, ACTH, and new synthetic drugs. Less than ten years ago the first patient to receive penicillin died simply because insufficient penicillin existed to continue the initial treatment. Now units of penicillin cost almost as much to pack as to produce and other major antibiotics have widened the range of chemotherapy—chloromycetin, streptomycin, aureomycin, and terramycin, the first of which has already been synthesised.

Two closely related aspects of these and other drugs are being investigated by the MRC—their actual mode of action upon disease-producing organisms and the tendency for strains of bacteria to emerge with exceptionally increased survival capacity. Thus, at Cambridge it has already been shown that the action of penicillin upon bacteria is nutritional;

or, more accurately, anti-nutritional since it prevents bacteria from assimilating a vital amino-acid. If it is known why a drug controls an organism, it may then be possible to supplement its action so that resistant strains do not develop during treatment. It is lack of such fundamental knowledge today that limits the promise of streptomycin as an effective drug for tuberculosis. However, the additional use of *p*-aminosalicylic acid (PAS) has already been found to reduce bacterial resistance to streptomycin.

Research on cortisone and ACTH is not exclusively American. British work has been limited by the fact that only small amounts of these two outstanding drugs have so far been available here, an expectable difficulty in view of the acute scarcity that still remains to be overcome in the U.S.A. A single kilogram of cortisone has been given by Messrs. Merck and Co. Inc., of New Jersey, for joint research use by the MRC and the Nuffield Foundation. It may sound a small enough quantity; but those with any idea of the scarcity of this anti-arthritic drug will know how generous this 1950 gift was. Yet it may in the end prove an advantage that the large-scale

usage of these two drugs is prevented by their cumbersome production troubles. They do not cure the diseases they affect; they alleviate miraculously but prolonged dosage is required and this in turn can lead to other effects—heart trouble, mental disturbances, glandular over-activity, etc. While only small quantities can be made available, research uses must dominate the development story. By the time the supply situation enables fairly widespread distribution to be made, a substantial amount of research information will be available. Already, for example, it is being realised that careful administration will help to reduce the complications of undesirable reactions.

Will British production of cortisone and/or ACTH become possible? ACTH is derived from animal pituitary glands by a lengthy and cumbersome series of operations, but steps have already been taken to encourage British extraction; so far the product has been extremely difficult to purify and standardise. Cortisone, also lengthily derived from deoxycholic acid, a steroid found in animal bile, can now be rather more easily produced from steroid substances of vegetable origin. The MRC has certainly not been slow in approaching the production problem from this latest angle, for even in 1950 an expedition had been sent to

Nigeria to see if likely plant sources for the required steroid chemicals existed there.

If these are the 'big name' medicinal chemicals of our time, it must not be assumed that they overwhelmingly dominate the chemical front of medicinal research. New and better drugs are being developed for tropical diseases such as amoebic dysentery, bilharzia, and filariasis. In some cases the wartime drugs are being replaced by equally effective substances with much less toxic side-effects. Out of pre-war research that led to the medical use of curare alkaloids a new series of drugs, the methonium compounds, has now emerged. Basic principles of chemical synthesis opened this new door. The most active nerve-paralysing compounds synthesised on the 'pattern' of curare's active principle were found to have a typical molecular structure. Now it is becoming clear that different length carbon chains in this family pattern of compounds dictate to some extent the specific parts of the nervous system which the compounds affect. Not only have new anaesthetic drugs been produced but also drugs that seem promising for the treatment of two of modern man's increasing penalties—gastric ulcers and high blood pressure.

## On Other Pages

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## Notes & Comments

### Earnings of Industry

TRUTH about prices and profits is admirably summarised in the 1951-52 edition of 'The Earnings of Industry,' issued by Aims of Industry, Ltd. (published by Hollis & Carter). Despite the size of some of the largest British companies it is pointed out that they are not under the domination of a small clique of wealthy men. Imperial Chemical Industries, Ltd., have, for instance, about 146,000 shareholders and 88.2 per cent of the holdings do not exceed £500. The phrase 'ploughed back' is explained and it is emphasised that unless money can be put aside out of earnings there can obviously be no research, no improvements and no opening up of new markets. The fallacy of the present taxation law is that although certain sums are allowed to be set aside for replacement of plant and equipment, these amounts are based on the *original cost*, not at the charges incurred today. I.C.I. recently revalued the manufacturing assets of the group on the basis of its replacement costs on 1 January 1950. That revaluation showed that the replacement cost is about £96,000,000 above the book cost, which in itself would be about £128,000,000. The importance of the chemical industry and allied trades is shown by the fact that in 1950 it employed 429,600 with a capital investment of £1,600 behind each job. A number of firms, including Boots Pure Drug Co., Ltd., Monsanto Chemicals, Ltd., B.D.H., Ltd., Evans Medical Supplies, Ltd., Fisons, Ltd., and I.C.I. gave analyses showing the break up of every £ of receipts. The amount placed to dividend or reserve averaged about three pence or four pence in the £. This can hardly be considered excessive for an industry which employs so many and contributes so much to the general welfare of the community.

### Green Grow the Brushes O

ANOTHER case of putting natural products to uses Nature never intended for them is arising over chlorophyll. This unsuspecting substance,

for years content to synthesise sugars from carbon dioxide, light and water, in plants all over the world, now finds itself being rudely extracted from its natural surroundings and injected into pills, detergents, embrocations, etc., for the exclusive use of human beings. History repeats itself, and the same race that covered itself with woad—which was blue and came from wood—is now being urged to plaster itself with chlorophyll—which, as everybody knows, is green and comes from such things as grass. The reason given for this quaint idea is, of course, a scientific one. Chlorophyll is said to abolish undesirable smells. The ancient Britons perhaps used woad for a similar reason, although they did not have vanishing creams and small pills with which to introduce it into the body, but merely smeared it on by hand, a method which had the added advantage of frightening away unwelcome visitors. The latest method of application is to mix chlorophyll with toothpaste so that when one breathes out, presumably, one exudes over one's next-door neighbour a delicate smell of new-mown hay, more becoming to a horse than a human being. The logical conclusion to this sort of behaviour is to move out into the paddock, where there is more chlorophyll than anyone could possibly want, all free. After three months on a diet of grass, nobody could conceivably smell of anything, if the toothpaste-makers are right. Yet cows manage to do so, somehow.

### Infringement of Copyright

IT is to be hoped that the scientists have investigated thoroughly all the possible effects of chlorophyll on the human organism. Nature has sometimes an unpleasant habit of repaying us in kind for pirating her copyrights, and the would-be smell-remover would do well to ponder that chlorophyll and haemoglobin, the colouring matter of blood, are constitutionally very alike. Nobody wants to see a green man if his nerves are not good. He might also reflect, perhaps, that even miracle-workers have their limitations. Not even



chlorophyll will deceive his wife when he comes home, singing, at three o'clock in the morning.

### Fertilisers Subsidised

**T**HERE were many critics of the last Government's 1949 decision to remove the subsidies from fertilisers. Even people whose general attitude towards subsidies was disapproving were among those who felt that a special case existed for the needs of the soil. The critics have been proved right. Almost exactly five months from the day the last part of the fertiliser subsidy was taken off, the new Minister of Agriculture announced that there would be a retrospective 30 per cent payment towards the cost of acquiring phosphatic fertilisers. At the time of writing these comments it is not known how this new subsidy will be paid, whether to farmers after form-filling or direct to the manufacturers in the same way as the previous subsidies were paid. Members of the industry and farmers must wait until fuller details are announced. From a public relations angle it will be a pity if the subsidies are paid direct to the manufacturers for there is always a suggestion that subsidies are paid to offset the inefficiency of the receivers. In fact, of course, no fertiliser subsidies would be needed if farmers could charge world prices for their produce instead of working on a 'bulk-transaction' scheme settled by periodic price reviews. Those who contend that fertiliser subsidies are

still not needed might study the catastrophic drops in demand that followed subsidy removal this year. The new subsidy applies to phosphatic fertilisers only—presumably to superphosphate, basic slag, rock phosphate, and compounds containing these types of phosphate. It can be assumed, too, that the 30 per cent assistance will be calculated on the cost of the phosphate in a compound fertiliser and not upon its total price. Any other interpretation of the brief announcement in the Commons would bristle with anomalies.

### The One Danger

**T**HERE is one danger in the new selective method of subsidy payment—water-soluble phosphate is the nutrient most affected by sulphur scarcity. Will the fact that this nutrient is subsidised while nitrogen and potash are not encourage too great a demand for it? No plant food is more vital for our soils. Its present high world price had discouraged farmers' purchases to an alarming extent. If the pendulum of economic tinkering now makes a full swing in the opposite direction there will be so severe a shortage of phosphate in 1952 that new controls over use and need may have to be introduced. The industry in any case will quickly find their current position of costly stagnation changed into the old annual problem of excessive demand. Their short and sudden experience of business depression seems ended.



*Warerite Limited's stand at the Building Exhibition, which was held at Olympia, 14-28 November, showed the many uses for laminated plastics in the home. In this reproduction of a kitchen/dining-room, Warerite panelling was used for all the walls and ceiling. The Redwing fittings in the kitchen were surfaced with the same materials, and the cupboards, niches and table on the right-hand side were similarly treated*



# Availability of Chemicals in Europe

## OEEC Memorandum on Exportable Surpluses

CHEMICAL industry in a number of countries has, particularly in recent years, been faced with a situation in which productive capacity has given rise to a supply of chemical commodities in excess of the demand for them.

This problem was first seriously noticed by the Chemical Products Committee of the Organisation for European Economic Co-operation at its session in September, 1948, when it was realised that this difference between production and requirement, instead of being an embarrassment to the country concerned might prove of value for export.

Further study was therefore given to the matter by the committee in 1949, when these exportable surpluses, as they came to be called, were found to be an increasing difficulty. 'Exportable surpluses' were defined as: actual surpluses, that is stocks not covered by orders (not including working stocks); and, potential surpluses, that is that part of working capacity unused owing to lack of demand.

### Periodic Memoranda

Several countries found themselves increasingly concerned with surpluses in various products. In November, 1949, therefore, the Organisation for European Economic Co-operation, thinking that the circulation of information on supplies of chemical products available for export might help the growth of intra-European trade and enable the participating countries to effect the saving in dollars which is their aim, decided that memoranda should be issued periodically giving, in as great detail as possible, particulars of the exportable surpluses now in existence and the potential monthly surpluses of chemical products.

The first memorandum giving the surpluses on 1 February, 1950, was issued in March, 1950, a second, giving surpluses on 1 July, 1950, in September, 1950, and a third giving surpluses on 1 January, 1951, in May, 1951.

As in the previous issues, the latest memorandum now published (No. 4) is printed throughout in French and English and sets out the position as at 1 July, 1951.

Details are given of exportable surpluses

in Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, Trieste, Turkey, and the United Kingdom, all of which answered the request; of the OEEC. Greece, Ireland and Portugal did not reply, while Iceland and Luxembourg indicated that they had no surpluses of chemical products.

### Data Indicative

In the present rapidly changing situation for raw materials exportable surpluses are extremely hard to estimate. In view of the time necessary for collation and publication information supplied may well have become out-of-date and the data should be regarded as indicative only.

Nevertheless, it is felt that continuation of the booklet is desirable as it might well facilitate the obtaining of supplies of certain products which have become scarce in some countries while still available in others.

Most countries did not provide precise quantities of surpluses either at a given date or in the form of regular monthly estimates, but indicated whether the supplies for export were 'limited', 'adequate' or 'ample.' The three terms were defined as follows: 'Limited': some but not all of the export demand can be met; 'adequate': all the export demand can be met; 'ample': all the export demand can be met as well as any reasonable additional demand.

Great Britain's list under the heading of 'limited' is a very long one and includes such items as:—

Chlorine; carbon blacks (certain grades); sulphur chloride; nitric acid; hydrogen peroxide; ammonia; solid caustic soda; caustic potash lyes; barium hydroxide; aluminium, iron, mercuric and tin oxides; manganese dioxide; activated earths; ammonium, calcium and aluminium chlorides; sodium and barium sulphides; sodium nitrite and nitrate; acids, anhydrides and acid chlorides and their halogenated, sulphonated and nitrated derivatives, salts and esters; penicillin and streptomycin; cellulose derivatives; and products obtained by condensation and polymerisation.

Under the heading of 'adequate' the British list includes: activated carbon; hydrofluoric acid; arsenical acids; silica gel;

boric acid; tin tetrachloride; mercury chloride; magnesium and copper sulphates; ammonium carbonate and bicarbonate; sodium carbonate; sodium and potassium silicates and metasilicates; vitamins A and D; disinfectants, insecticides, etc., including chloramine-T.

'Ample' surpluses shown by Britain were less numerous, but included alginates; chemical fluxes; printing inks; synthetic and chemically modified natural waxes.

Under the heading of 'Inorganic Acids and Oxygenated, Halogenated and Sulphurated Compounds of Metalloids,' Italy seemed to have the best supplies as follows in metric tons:—

	Actual surplus	Potential monthly surplus
Hydrochloric acid	500	850
Chloro-sulphonic acid	60	150
Carbon disulphide	200	2,000
Sulphuric acid (100%)	500	2,000
Nitric acid	—	500
Phosphoric acid	30	50

Italy also showed potential monthly surpluses of nitrogenous fertilisers as follows: 5,000 metric tons calcium cyanamide (from August, 1951, to March, 1952); 4,000 metric tons ammonium sulphate (from August, 1951, to June, 1952).

Most surpluses listed were 'limited' or 'adequate,' but 'ample' quantities shown by various countries included the following:

**Belgium:** calcium hypochlorite; barium sulphate; calcium carbide; carboxymethylcellulose.

**France:** Superphosphates; activated carbon; activated earths; magnesium chloride.

**Germany:** Potash fertilisers; ethyl alcohol.

**Netherlands:** Silica gel; silicic acid; potassium and sodium silicates; linalyl acetate; benzoic acid; sodium benzoate; phenylacetic acid; para-amino-salicylic acid and its salts; synthetic tanning products; disinfectants based on phenols and their derivatives.

**Norway:** Inert gases of spectral purity, such as argon, helium, neon, and xenon.

The whole memorandum is divided into 15 chapters and is over 150 pages. There is also a useful list of professional associations in the 13 countries from which information was received, which will provide additional details of the surpluses mentioned. A full index at the end of the booklet enables any particular item to be readily looked up.

## Italian Sulphur

### Government to Modernise Plant

**WRITING** in *La Chim. e l'Ind.*, 1951, 33 (10) 671-672, E. Vareton Re observes that in 1950 Italy contributed only 224,000 tons of sulphur to the world total of 5,700,000 tons, the remainder coming mainly from the U.S.A. For 1951 the world deficit had been estimated to be about 1,000,000 tons. In regard to the views expressed in the U.S.A. and elsewhere that Italy ought to be able to supply all the needs of Western Europe, he says one of the difficulties has been competition with low-priced sulphur from the U.S.A. Italy and Sicily also suffer from other disadvantages such as inferior or difficultly accessible deposits, lack of fuel at reasonable prices, and poor transport facilities. That is not to say, of course, that methods of production could not be greatly improved and output increased; but both incentive and means have been largely lacking.

However, the Government has recently decided to spend a lot of money on modernising plant and equipment, and still more on geological research for new deposits, which it is thought still exist abundantly in Sicily. If these efforts succeed it is thought that Italy could provide European manufacturers with the elemental sulphur required in such industries as carbon disulphide, rubber and agriculture, which comprise about one-quarter of the demand for sulphur; much of the balance being needed for sulphuric acid. In this latter case the tendency now is to employ other basic material such as pyrites rather than elemental sulphur, and Italy is rich in this material.

### Making Sound Progress

Output of Italian pyrites, mostly by the Montecatini Company in recent years places her at the head of the world's producers, and the Montecatini Co., with an output of 774,500 tons in 1950, is second only to the Rio Tinto Company (836,000 tons in 1950). A beginning has also been made in Italy in the recovery of sulphur from gases, for example at petroleum refineries, and this has now reached about 3,000 tons per annum.

With regard to the future, Vareton Re says Italy must also consider the possibility of manufacturing *in situ* chemicals and fertilisers.

## MIDLANDS ANALYTICAL METHODS DISCUSSION GROUP

## Some New Analytical Indicators

At a recent meeting of the Midlands Analytical Methods Discussion Group, Mr. W. I. Stephen, B.Sc., A.R.I.C., of the Analytical Chemistry Research School, Birmingham University, introduced the topic 'Some New Indicators in Analytical Chemistry.' His address was as follows:—

During recent years many new and varied types of indicators have been proposed. These can conveniently be divided into four main classes:—

I. Acid-Base (single, mixed, screened, universal).

II. Redox (including iodometric, iodate, bromometric, and hypochlorite indicators).

III. Adsorption.

IV. Miscellaneous.

This classification is by no means comprehensive, but most of the new indicators to be described fall conveniently into one or other of the above classes.

It is unfortunate, perhaps, that so many acid-base indicators have been examined within the last decade or so, as there is no pressing need for these. The conventional acid-base indicators are generally satisfactory in most titrimetric processes involving neutralisation reactions. However, certain indicators have been proposed which have distinct advantages over some of the earlier indicators, and, therefore, a brief survey of recent developments in this field may be given.

## Methyl Orange Substitute

Lente and Pope (1947) have recommended *p*-dimethylamino-azobenzene sulphonamide (pH 3-4.5) in place of Methyl Orange. The structure of the molecule is very similar to that of Methyl Orange, a terminal sulphonamide group replacing the sulphonic acid of the Methyl Orange molecule. As a result, the compound is more difficultly soluble than Methyl Orange, and lighter shades of colour are thus obtained in solution. The main advantage over Methyl Orange is the disappearance of the intermediate orange shade, the indicator colour change being from red to yellow.

A new single indicator with a one-colour change is ethyl *bis*-(2,4-dinitrophenyl)acetate (pH 7.5-9.1) proposed by Fehnel and Amstutz (1944). The indicator changes from

colourless in acid to deep blue in alkali, and is useful in place of phenolphthalein when red or orange-coloured solutions have to be titrated.

Scanlan and Reid (1935) used Benzoyl Auramine G (pH 5-5.6) as indicator for Kjeldahl nitrogen determinations. Its narrow pH range enables a sharp colour change of pale yellow to violet to be obtained at the end-point. The violet acid form of the indicator exhibits marked dichroism, but this, fortunately, does not render the colour change any more difficult to detect.

Bromophenol Blue is also dichroic and, in this instance, some difficulty is often encountered in detecting the end-point. As early as 1929, Harden and Drake proposed Tetra-bromophenol Blue, which possesses identical properties to Bromophenol Blue, but is not dichroic. For some reason, it is not yet commercially available in this country.

## New Series of Indicators

A new series of pyrazolone indicators has recently been suggested by Musanté (1946). He prepared a pyrazolyl-triazine which changes colour from greenish-yellow, through orange, to violet-red, over the pH range 4.8-14. During an actual titration, a change from colourless in acid to pale orange-yellow over the pH range 7-8.5 is observed. This compound is claimed to be very satisfactory as an indicator in the titration of acids whose primary dissociation constants lie between  $2 \times 10^{-3}$  and  $1 \times 10^{-7}$ , provided N or 0.1N alkali is used.

Glockner (1949) has described the use of *m*-xylenolphthalein (pH 8.2-9.9) in place of phenolphthalein. The change is from colourless to violet and the indicator is claimed to be particularly useful in the titration of weak acids.

Ferber (1946) has discussed the preparation of three new indicators, which change from a red neutral form to a blue alkaline form over various pH ranges. The indicators are Alpha Blue (pH 8-10), Nitroanisole Blue (pH 9-11) and Epsilon Blue (pH 11-13) and give pink to pale purple colour changes. Alpha Blue is useful for distinguishing between carbonate and bicarbonate, and

Epsilon Blue for controlling the alkalinity of di- and tri-sodium phosphate mixtures.

Seven dyestuffs have been recommended by Konopik and Leberl (1948) for the colorimetric determination of pH. The indicators, which can be used in alkali sulphide solutions, are Neutral Blue R (11-12), Chrome Fast Orange R and Lanacyl Violet (11-15), Carbazole Yellow W (12-14), Chlorantine Light Blue G.L.N. (13-14) and Celestine Blue (14-15).

#### Acid-Base Indicator

A single type acid-base indicator suitable for use in strong carbonate solutions is Hessian Purple N Extra (or Direct Purple), suggested by Taras (1947). The alkaline solution is red, changing to mauve at pH 4.0, sharply to purple at pH 3.8 and to bluish purple at 3.0. The sharpest change (pH 3.8) is readily observed even in artificial light.

Ma and Zuazaga (1942) have used a mixture of Methyl Red and Bromocresol Green as indicator in Kjeldahl ammonia titrations. In 2 per cent boric acid solution, the indicator gives a bluish-purple colour, changing to bluish-green in presence of ammonia and to pink with a trace of acid. Some workers prefer a screened Methyl Red/Methylene Blue indicator for this titration. It is not known whether these indicators can be used in the titration of mg. amounts of ammonia in comparatively large volumes (ca. 500 ml.) of water.

The acidimetric titration of carbonate is of importance. Methyl Orange is the classical indicator for this titration, but there are several more suitable. Without doubt, the best available indicator for carbonate titrations is that of Hoppner (1936), consisting of a mixture of Dimethyl Yellow and Bromocresol Green. The colour change is from yellow to blue (pH 3-4).

Some screened indicators have also been recommended for this titration, those of Hickman and Linstead (1922) and Carmody (1945) being noteworthy. The former consists of Methyl Orange screened with the neutral dyestuff Xylene Cyanol FF, which changes from red to green over the pH interval 3-4.4. Carmody uses Dimethyl Yellow and Methylene Blue, which changes from pink to yellow-green over the pH range 2.9-4.0.

A critical study of these carbonate indicators has been made by West (1951). Forty-

five independent opinions confirmed that Hoppner's indicator was the best of those available, while Methyl Orange was regarded as the least satisfactory.

Another useful screened indicator, recommended by Krishnamurty (1948), consists of a mixture of Tropolein 000 No. 1 and Malachite Green. He found that a 1:1 mixture of these substances gave the best end-point in the titration of carbonate to bicarbonate with hydrochloric acid.

Several universal indicators have been proposed in recent years. However, their importance has diminished somewhat, and it is not intended to discuss these further.

Perhaps the most important class of indicators is that comprising those substances which act as indicators in redox titrations.

In titrations involving the use of ceric sulphate as oxidant (ca. 1.5 v.) indicators with a high oxidation potential are used. The well-known 1:10 phenanthroline and  $\alpha,\alpha'$ -dipyridyl metal complexes are the most widely used. Smith and Brandt (1949) have recently reviewed the properties of these substances and reported a wide range of potentials between 0.84v. and 1.25v. for some 25 ferroin-type compounds. The most recent indicator of this type, proposed by the same workers, is 5,6-dimethyl phenanthroline (0.97v. in N acid). It is thus possible by examining the potentials involved in any ceric titration to choose the best indicator for the experimental conditions.

#### Dichromate-Ferrous Titrations

Diphenylamine and its *p*-sulphonic acid derivative have long been used in dichromate-ferrous titrations, where the potentials involved are lower than those in cerous-ceric systems. Willard and Manolo (1947) have examined several diphenylamine derivatives and employed them in new titrimetric procedures. They added an excess of standard ferricyanide to trivalent arsenic, antimony and chromium, and hydrazine sulphate solutions, made the solution alkaline and titrated the excess ferricyanide with vanadyl sulphate using one of these diphenylamine derivative as indicator. 2-Carboxy-2'-methoxy-diphenylamine is especially recommended for use with the ferricyanide-vanadyl system. The colour of the oxidised indicator is red, changing to colourless at the end-point, a distinction from the

usual blue oxidation colour given by these substances in acid solutions.

Another application of these diphenylamine derivatives is in the direct titration of thiosulphate, thiocyanate, and trivalent antimony with alkaline hypobromite. Knop and Kutelkova-Knopova (1941) recommended *N*-methyl-diphenylamine-*p*-sulphonic acid, which is more sensitive than diphenylamine in ferrous-dichromate titrations and which also gives a more stable oxidation product.

Among the more important recent redox indicators are naphthidine and its 3,3'-dimethyl derivative, which latter may be denoted as DMN.

Naphthidine and DMN have been applied with success by Belcher, Nutton and Stephen (1951) to the titration of zinc, cadmium, calcium and indium. In the zinc titration, the conditions recommended by Kolthoff (1947) are employed, i.e., a back titration at room temperature. Naphthidine gives a colour change of greyish-white to red-pink, and DMN changes from greenish-white to red-violet. These workers have carried out a critical survey of the indicators recommended for this titration—diphenylbenzidine, *o*-dianisidine, *p*-ethoxy-chrysoidine, etc.—and reported that both naphthidine and DMN are immeasurably superior in all respects, with DMN the best of all. Two further advantages of DMN are (a) it has an exceptionally stable oxidation product, and (b) its colour change is very sensitive. Using this indicator, it is possible to carry out titrations of M/1,000 zinc solutions.

Cadmium solutions can be titrated directly with standard ferrocyanide solution using naphthidine or DMN as indicator, the colour change being sharp from red to white. This is the first direct titration method for cadmium.

Indium can also be titrated using these two substances as indicators. Here, a back-titration technique is employed and the end-point changes (white to red) are very sharp.

#### Naphthidine and DMN Properties

More recently, the same workers prepared the sulphonic acid derivatives of naphthidine and DMN, and found that these had excellent indicator properties. Indeed, in the zinc-ferrocyanide titration sharp end-point colour changes were obtained using a direct titration procedure. Both sulphonic acids can be used in ferrous-dichromate and

ferrous-vanadate titrations, although here the naphthidine sulphonic acid is easily destroyed.

The well-known blue starch-iodide complex is caused by the reaction of amylose—a starch constituent—with free iodine in the presence of iodide. Amylose alone is recommended in place of starch and is claimed to be more sensitive than soluble starched solutions.

#### Starch as an Indicator

Peat, Bourne and Thrower (1947) synthesised sodium starch glycollate and found that it possessed all the advantages of starch as an indicator, but few of its disadvantages. These workers also prepared the corresponding amylose compound which has a greater sensitivity, but it is difficult to prepare and is not a commercial proposition.

Starch, and sodium starch glycollate do not function in alcoholic solution nor does polyvinyl alcohol recommended by Miller and Bracken (1951). This latter substance, or rather partially acetylated polyvinyl alcohol, gives a crimson colour with iodine in the presence of iodide and is claimed to be considerably more sensitive than starch.

It has been found that a 1 per cent solution of soluble starch in 25 per cent sodium chloride will keep indefinitely.

Smith and Wilcox (1942) used three organic dyestuffs as indicators in the well-known Andrews iodate titration, where previously the disappearance of the colour in a carbon tetrachloride layer denoted the end-point. These new indicators—Naphthol Blue Black, Brilliant Ponceau 5R, and Amaranth—are irreversibly destroyed at the end-point by a trace of iodate in excess. Although these indicators represent a great improvement on the classical method, their one disadvantage is their irreversibility. In an attempt to find a reversible indicator for this titration, Belcher and Clark (1950) examined several organic dyestuffs. Two of these were found to act reversibly, viz.,  $\alpha$ -naphthoflavone and *p*-ethoxy-chrysoidine. However,  $\alpha$ -naphthoflavone forms a complex with free iodine, which makes the end-point insufficiently sharp for general use. *p*-ethoxy-chrysoidine gives a sharp colour change from red to deep purple just prior to the end-point, and a further drop of titrant produces an orange colour at the end-point. Although some destruction of the indicator occurs during the end-point

oxidation, the titration can be repeated at least twice should the end-point be overshoot.

Many organic dyestuffs are readily destroyed by excess of bromate, or rather by the free bromine liberated by excess of bromate in an acid-bromide solution. As a result, few reversible indicators are available for bromometric titrations; most are irreversible. Smith and May (1941) used Bordeaux Naphthol Blue Black and Brilliant Ponceau 5R as irreversible indicators, the intense colours of which are bleached at the end-point. In an attempt to break away from simple bleaching effects, Hahn (1942) has recommended Fluorescein as an irreversible indicator in the bromometric titration of arsenite solutions. At the end-point the pale yellow-green Fluorescein is brominated to form the red-coloured Eosin. The titration is carried out at 40-50°C., as the end-point colour change is slow at room temperature.

#### First Reversible Indicator

Szebellédy and Schick (1934) described the use of selenious acid as the first reversible indicator for bromometric titrations. This substance is reduced to deep-red colloidal selenium in the presence of arsenite, and is re-oxidised by a trace of bromine in excess. The indicator is only of use in arsenite-bromate titrations. Szebellédy and Madis (1948) suggested osmic acid as indicator, which can be reversibly reduced to the metal. Other inorganic substances which have been used are trivalent gold salts, manganous sulphate and Molybdenum Blue.

The first reversible organic indicator used in bromometry was  $\alpha$ -naphthoflavone, discovered independently by 1935 by Uzel and Schultz. The colour change, pale straw to deep brownish orange, is easily observed. Other organic compounds recommended are apomorphine (Szebellédy and Sik (1937)), Rupropfen (Szebellédy and Madis (1948)), *p*-ethoxy-chrysoidine (Schulek and Rozsa (1939)), and Fuschin (Raykhinsteyn and Kocheringina (1948)). Belcher (1950) carried out a critical examination of these indicators and found that the most suitable were  $\alpha$ -naphthoflavone, *p*-ethoxy-chrysoidine, Fuschin and apomorphine. He favoured  $\alpha$ -naphthoflavone in arsenite-bromate titrations, although one worker prefers *p*-ethoxy-chrysoidine. A point in favour of  $\alpha$ -naphthoflavone is that it is less readily destroyed when the end-point is passed and

repassed. Belcher preferred *p*-ethoxy-chrysoidine for use in antimonite titrations. He extended the use of  $\alpha$ -naphthoflavone to the indirect determination of aluminium. Here, the precipitated aluminium oxinate is dissolved in acid, bromide added, followed by excess of standard bromate, then excess arsenite, and the titration completed with bromate. This procedure is essential, as the bromination of the oxine molecule is somewhat slow.

In connection with *p*-ethoxy-chrysoidine, it may be mentioned that it is used as an acid-base, redox or adsorption indicator and it may, therefore, be regarded as a true universal indicator. Schulek and Rozsa (1939) showed that this dyestuff possessed remarkable properties, and a later paper by Schulek and Somogyi (1948) described in detail an examination of some thirty similar dyestuffs. Several of these proved to be valuable indicators, but perhaps the most important feature of the examination is the attempted correlation of molecular structure and indicator activity.

Belcher (1951) discovered that Quinoline Yellow could be used as a reversible indicator in the bromometric titration of trivalent arsenic and antimony, the colour change being from colourless to deep yellow.

#### Bordeaux and Amaranth

The dyestuffs Bordeaux and Amaranth act reversibly in hypochlorite titrations, their colours being bleached at the end-point. Belcher (1950) has recommended Tartrazine which acts reversibly in arsenite-hypochlorite titrations. The change is from deep yellow to colourless, and the indicator functions satisfactorily, but only if not too great an excess of hypochlorite is added after the end-point is reached. Quinoline Yellow has also been suggested as indicator for these titrations by Sinn (1948), but later workers contradicted his findings. Belcher (1951) has cleared up this situation, and has found that the indicator acts reversibly and is eminently satisfactory in other respects. It is more stable at the end-point than Tartrazine, and the end-point can be passed and repassed repeatedly without any noticeable destruction of the indicator. The change is yellow to colourless. Tartrazine is the first reversible indicator to be advanced for hypochlorite titrations.

Since the pioneer work of Fajans (1924), few advances have been made in the theo-



retical\* and practical study of adsorption indicators. Only a few of the numerous substances recommended in recent years need be mentioned. Tartrazine was used by Berry (1947) in the Volhard titration of chloride, none of the usual precautions, such as the addition of nitrobenzene, etc., being necessary. End-points are by no means satisfactory, and on many occasions, cannot be detected. Mehrotra has investigated several acid-base indicators as possible adsorption indicators, and found that some, e.g., Congo Red, Bromophenol Blue, Bromothymol Blue, Bromocresol Purple give colour changes. All these have been used in the argentometric titration of halides and thiocyanate, but some workers claim that the end-points obtained are worse than those obtained with the conventional indicators of the Fluorescein type.

Congo Red may be described in greater detail, as the mechanism of its reaction differs somewhat from that of the other adsorption indicators. Congo Red is an acid-base indicator (pH 3-5) with a colour change of blue to red. All the argentometric titrations are done in this pH range, where both the red anions and blue cations of the dyestuff co-exist. When excess of silver is present, the silver halide is positively charged and can preferentially adsorb the red anions of the dye. This adsorption disturbs the equilibrium of the partially dissociated dyestuff, and more anions are produced, until adsorption of them is complete. In the presence of excess of halide, the silver halide is negatively charged and can preferentially adsorb the blue cations. This change of colour is claimed to be very sharp, and is completely reversible at the end-point.

#### Adsorption Indicators Over-rated

Mehrotra has also used Bromophenol Blue as adsorption indicator in the titration of thallium with iodide and has extended its use to the determination of mixtures of silver and thallium.

There is no doubt that adsorption indicators have been much over-rated. If electrolytes are present in any amount the efficiency of the indicators is seriously impaired and they become virtually useless.

Among the miscellaneous indicators to be discussed are some which could be classified in other groups, but which are perhaps better described under the above heading.

Hirsch (1948) has employed a lead acetate-dithizone indicator for use in acid-base titrations, especially where the solution to be titrated is dark coloured. A small amount of lead acetate and a solution of dithizone in chloroform is added to the solution to be titrated. If the pH of the solution is less than 4, most of the lead remains in the aqueous solution and the organic layer is coloured green. If the pH is greater than 4, the organic solvent extracts some of the lead and becomes red in colour, due to the formation of the lead-dithizone complex. The method has several obvious limitations, since the colour of the solution may also be extracted and other metals will interfere.

#### Titration of Cyanide

Ubbelohde (1934) proposed nickel dimethylglyoxime as indicator in the argentometric titration of cyanide. When silver nitrate is added to cyanide solutions, the complex argenticyanide anion is formed. As long as cyanide is present in excess, the nickel in the indicator is bound as the colourless cyanonickel dimethylglyoxime. When cyanide is no longer in excess, silver ions combine with the cyanide of the indicator complex, and the characteristic pink colour of the nickel dimethylglyoxime appears.

*p*-Dimethylaminobenzal-rhodanine forms a red-coloured complex with silver. Ryan and Culshaw (1944) used this compound as indicator in the argentometric titration of cyanide. Excellent end-points were obtained especially in solutions of concentration N/50 or less.

Burriel and Sierra (1932) proposed benzidine in the presence of cupric ions as indicator for the titration of silver with bromide or iodide. Belcher and Nutten (1951) have examined the reaction and recommend 3-methyl- and 3,3'-diethyl-benzidine as being more sensitive than benzidine. The end-points are much sharper than those obtained with the unsubstituted base.

These substances have also been applied to the titrimetric determination of mg. amounts of gold with hydroquinone, and give better end-points than the conventional indicator, *o*-dianisidine.

A novel type of indicator has been suggested by Kurtz and Kenny (1950). They use the substance 'siloxene' as a chemiluminescent indicator in redox titrations, the first trace of oxidant in excess causing the

indicator to emit light. The indicator is mainly used in cerate oxidimetry and is useful in titrations of highly coloured solutions. Titration should be carried out in a darkened room. In a later paper (1951), these workers suggested the use of 'luminol' as a chemi-luminescent acid-base indicator. It is used in conjunction with hydrogen peroxide, with haemoglobin as catalyst (the iron providing the active part of the catalyst). Again the indicator emits light at the endpoint (between pH 7-12) and again titration is effected in a dark room. Solutions containing dyestuffs such as Gentian Violet have been satisfactorily titrated using this method, normal indicators being useless in this instance.

## Pocket Atomic Reactor

To Produce Fast-Decaying Isotopes

THE development of a 'vest pocket' atomic reactor opening the way to far more widespread peacetime use of radioactive materials is announced by North American Aviation Incorporated, the *New York Times* reports. The reactor, an octagonally shaped 'atomic oven,' 19 feet in diameter, is still in the testing stage. It uses uranium as 'fuel' and will produce energy at a constant rate of 160 kilowatts. The smallest of its kind, the oven is not a power generator, it is reported. It operates, by intention, at too low a heat level to make this practicable. It is intended for such purposes as producing radioactive chemicals and streams of neutrons for medical radiation treatments.

The significance of the development is that for a comparatively small sum—estimated at \$1,000,000—any institution or organisation can provide for ordinary civilian purposes essentially radiological 'tools' now available only on a limited basis from such major atomic installations as Brookhaven Laboratories, Long Island, or Oak Ridge, Tennessee. Potentially, this reactor can make available in all parts of the country radioisotopes that now cannot be supplied from Brookhaven and Oak Ridge to distant sections such as the Pacific coast because they decay so fast. An example is sodium 24, with a half-life of 14.7 hours. These isotopes are especially useful for delicate grading, measuring and

irradiation operations in medicine, industry and agriculture.

The new reactor is only about 100th the size of the Oak Ridge apparatus for similar purposes, and only one quarter to one-third as big as the Brookhaven reactor, which produces at a rate of 30,000 kilowatts against this machine's 160. The design, it is announced, will be made available through the Atomic Energy Commission to any institution or organisation that wants to build one. One could be built, the company estimates, in 17 months after the completion of 'component development and engineering tests' now scheduled for July, 1952.

## Radiation Preserves Foods

RESEARCH at Columbia University, U.S.A., has revealed that very large doses of radiation can preserve unpasteurised milk up to periods of seven weeks without recourse to heating or freezing. The radiations were produced with a 2,000,000-volt X-ray unit (they could equally well have emanated from an atomic pile), and no residual radioactivity in the milk was detected. Taste, appearance and nutritive value were unimpaired, it is reported, and vitamin content did not change. Samples received as much as 100,000 Roentgens of radiation, but even with 1,000,000 Roentgens no residual radioactivity was found (ten Roentgens are usually enough to kill a man). Storage properties depended on the amount of radiation administered; milk irradiated from available fission products kept at least one month under ordinary refrigeration.

The effect of these radiations is undoubtedly to destroy bacteria and other food-spoiling organisms and to check enzyme activity. Large-scale animal tests are being carried out in the U.S.A. now to determine whether there is any effect on growth rate, reproductive processes or hereditary characteristics after feeding animals with irradiated milk. An extension of the research is planned to other foodstuffs, and a possible application is for sterilisation of surgical instruments. One important result of the research if the irradiation is proved harmless to living creatures will be that the dangerous waste-products of atomic piles which now create such formidable disposal problems will be able to find good use as radiation sources.



## Research in the Gas Industry

### Gas Engineers' Autumn Meeting

**F**UTURE organisation of research in the gas industry was outlined by Colonel Harold C. Smith, deputy chairman of the Gas Council and chairman of the Gas Research Board, in a statement at the opening of the 17th autumn research meeting of the Institution of Gas Engineers held in London on Tuesday and Wednesday, 27 and 28 November.

After vesting date, a survey of the work then being undertaken and of the numbers of research workers engaged was conducted by Dr. W. T. K. Braunholtz, secretary of the Institution of Gas Engineers, and it was upon this report that the future plan for the organisation of research had been built.

Fundamental research was, the Gas Council considered, its prime responsibility. This was defined generally as seeking fundamental knowledge of existing processes and knowledge likely to lead to new ideas, processes and products, and their development, where appropriate, up to and including the pilot plant stage. Normal development of existing processes and appliances, was, in the council's view, a responsibility which might properly be undertaken by Area Boards.

#### Establishment of Research Committee

A research committee, under the chairmanship of Sir Edgar Sylvester, had been appointed by the Gas Council, and had reviewed the research conducted by the industry. On its recommendations, two research stations had been established.

The first was at Fulham, where the laboratories of the North Thames Gas Board were recognised as the nucleus of a research station. Dr. H. Hollings being appointed its director. The second had been established more recently in the area of the West Midlands Gas Board, its director being Dr. F. J. Dent, who was assistant director of the Gas Research Board. A third research station may be set up at a later date.

Work on complete gasification which was being carried out at Poole had been transferred to the West Midlands research station under the control of Dr. Dent, and all the staff had accepted appointments there. It was the intention of the Gas Council to accelerate the pace of this work, and priority had been given to investigations to be car-

ried out on complete gasification. It was also important that the research at Beckenham should continue as quickly as possible, and workers should not be discouraged by any change in organisation.

#### No Annual Reports

Unless there was some definite news of progress or difficulties that had been overcome, the Gas Council did not intend to produce reports. It was considered that too much time of research workers could be taken up in producing long and detailed annual reports, thus taking them off more important work in the laboratory.

Results of work would, however, be made available for discussion at the annual autumn meetings of the Institution of Gas Engineers.

While this might be satisfactory to the industry generally, it was felt that those engaged on scientific and technical work should have opportunities of considering and discussing the progress of the work at more frequent intervals. In order to provide for this it was the intention of the research committee of the Gas Council to establish a research liaison committee, consisting of the Livesey Professor, the directors of the Gas Council's Research stations and a suitable scientific or technical officer to be nominated by each Area Board.

The function of this liaison committee would be to keep each Area Board closely in touch with the progress of research which was being carried out and to keep the directors of research informed of problems arising in the industry. This liaison committee would have no administrative functions but would meet solely to discuss research problems. It was hoped that through it a much keener interest would be stimulated in the research work being carried out and also that the directors themselves thereby would be kept more closely in touch with the problems arising in the gas industry.

In conclusion, Colonel Smith said, the policy of the Gas Council might be aptly summed up in the words of Faraday, that the three necessary steps in useful research were: begin it, end it, and publish it.

A number of interesting papers were read and discussed during the two days of the

meeting, from which the following summaries have been taken.

'Measurement of Coal Travel in Continuous Vertical Retorts by Means of Radioactive Tallies', was presented by C. H. Lewis, of the Fulham Laboratory, North Thames Gas Board. His paper described a technique developed in the research laboratories of the North Thames Gas Board for investigating the travel of the charge in a continuous vertical retort.

Quenching techniques used hitherto, although they provided valuable information, were open to criticism, because the retorts involved were at the end of their useful life, and irregularities in coal travel which might not exist in newer retorts were likely to become prominent.

#### Radioactive Tally Used

In the new process a radioactive tally is introduced into the charge at the top of the retort, and its position is determined at intervals by means of water-cooled Geiger counters in the combustion chambers. The probable error in locating the tally is believed not to exceed 2 in., and a fairly complete picture of the path and rate of descent of the tally is obtained.

The method has the great advantage of being non-destructive, so that it can be applied to retort installations at any stage in their working life.

The exceptionally high paramagnetic susceptibility of oxygen is the basis of an instrument designed to record the oxygen content of a gas in the range zero to 2 per cent by volume. This was described by R. H. Griffith, senior chemist, North Thames Gas Board, in his paper 'A Magnetic Oxygen Recorder for the Automatic Control of a Catalytic Purification Plant'. This instrument has now been used, in conjunction with a pneumatic valve mechanism, for the automatic control of a catalytic plant in which organic sulphur compounds are removed from coal gas.

Pure sulphur may be recovered from ordinary gas works spent oxide by extraction with toluene, if certain precautions are taken. Experiments begun in 1950 at the Fulham Laboratory of the North Thames Gas Board were outlined by Dr. F. A. Burden and W. B. S. Newling in their paper 'Recovery of Pure Sulphur from Spent Oxide'.

Extraction is preferably carried out on

dried oxide in the temperature range of 100° to 110°C., between the boiling-points of water and toluene. The hot extract solution contains nearly all the sulphur and tar originally in the oxide, and is filtered free from oxide fines.

Crystals of pure sulphur can be formed from the tarry solution by slow cooling with continuous stirring, particularly if the solution is not allowed to cool below about 40°C. The tarry mother liquor may be separated from the sulphur crystals by drainage followed by rapid washing with cold toluene. The crystals contain an appreciable proportion of toluene which cannot be removed by ordinary drying methods, and this is driven off by fusing the crystals and heating the molten sulphur to 120°C.

The solidified melt contains less than 0.1 per cent of tar, and is equivalent in quality to the valuable material required for operation of the simplest type of contact sulphuric acid plant.

Possibility of using nitric acid and nitrous acid for the destruction of the residual toxic matter in ammonia still effluents, and other effluents from gas works were discussed by C. Cooper (director and head of the technical department), and W. E. Bouch (research and development department), W. C. Holmes & Co., Ltd., in their paper 'Investigations into a New Method of Effluent Liquor Purification'.

#### Destruction of Salts

The effect of the reactions is to destroy the inorganic salts, such as thiosulphate and thiocyanate, the products of decomposition of nitric acid being largely recoverable for further employment, after the gases evolved have been oxidised with air. Consequently, the total effect is to accomplish the conversion of these salts to comparatively harmless substances by indirectly employing atmospheric oxygen.

Phenolic matter which is present combines with nitric acid, which is thereafter unrecoverable. Nitric acid or nitrogen oxides for these purposes can be obtained by the catalytic conversion of ammonia.

Presence of chlorides, which is almost universally to be expected, has important effects on the course of the reactions. Primarily, chloride reacts in a manner that assists the decomposition of the other ammonia salts, but reaction will persist between ammonium chloride and nitric acid in solu-

tion, if allowed, after the process has reached its desired conclusion.

Nitrated phenols will exist in treated solutions and may require removal. Where solutions of thiocyanate of fairly high concentration are available, the possibility exists of a remunerative recovery of hydrocyanic acid.

'Treatment of Gas Works Liquor in Admixture with Sewage in Percolating Filters,' was the subject of the final paper presented by Dr. W. H. Blackburn (The Gas Research Board), and T. G. Tomlinson and T. H. Summers (Water Pollution Research Laboratory, DSIR).

In the first section of this paper the results were reported of an investigation of the effects of spent vertical-retort liquor on the treatment of sewage in full-scale percolating filters. It is hoped later to give the results of experiments with other types of gas works liquor resulting either from modified gas works practice or from special treatment of the liquor. The second section dealt with the method of separation and the treatment of seven fractions of crude vertical-retort liquor in admixture with sewage in small-scale experimental filters.

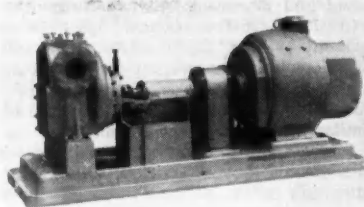
## Pulsometer Slurry Pump

### Many Possible Applications

IN the operation of coke ovens, gas works, and other carbonisation plants, as well as in many chemical works, oil refineries and other establishments, pumps are often required to operate under extremely difficult conditions. When the quenching and conveying water is only used once and then discharged to waste, ordinary pumps can be employed, but if the water is re-circulated and therefore contains a considerable quantity of grit and abrasive material, pumps of special construction have to be installed to withstand the severe wear and tear. In such cases the slurry pump made by the Pulsometer Engineering Co., Ltd., of Reading, which is a special centrifugal design, is said to be of particular value. The casing is of close-grained iron of extra thickness and a similar iron of extra thickness is used for the impeller which runs between renewable hard iron side plates.

A leading feature of the design is said to be the easy adjustment enabling the suction side plate to be moved towards the impeller, thereby restoring the original clearance and

compensating for any wear which has taken place. This adjustment can be made from the outside of the pump, without the dismantling of any part, and enables the impeller to continue in use while at the same time maintaining the original efficiency over a long period.



According to the makers, various improvements in the design of small centrifugal pumps have made it possible to use them in place of the uneconomical duplex steam pump, hitherto standard practice for by-product plants. The firm have also had extensive experience with the pumping of naphthalene, tar oil, creosote, benzole and ammoniacal liquor, lime water, solvents and wash oils, and other products, and are able to supply pumps constructed in the materials best suited for the purpose.

In the treatment of naphthalene and tar oil for example, liquids have to be dealt with at very high pressures, and these pumps are handling tar oils at temperatures up to 662°F. (350°C.). Such pumps are supplied with water-cooled stuffing boxes and bearings, which have eliminated packing water containing tar particles, while connections can be provided on all designs for steaming out if necessary.

### Wrinkle-Resistant Rayon

A new chemical process called 'X-Two' which, it is claimed, makes rayon fabrics permanently 'wrinkle resistant' and completely washable, was announced at the meeting of the United States Textile Research Institute recently. Mr. Russell Newton, president of the River Mills, Inc., where work on the process has been going on for seven years, said: 'It makes all-white rayon garments practical for the first time, since the process makes rayon fabrics immune to undesirable effects of chlorine bleaches and proof against yellowing.'

## IN THE EDITOR'S POST

## 'Silica &amp; Silicates'

SIR,—In reply to the letter of Mr. G. H. Osborn (CHEMICAL AGE, 24 November, 1951). I feel that he has misunderstood the purpose of the reports which appear in the CHEMICAL AGE. Taking the various minor points he raised and discussing them in turn:—

(i) I believe the article in question was correctly entitled 'The Analytical Chemistry of Silicon'. After opening-out silicon-containing materials by fusion, the amount of silicon present is eventually estimated. Similarly, the analytical chemistry of, say, sodium, is not directly concerned with the reactions of the metal itself, although the estimation of the amount of metal present is the eventual aim of a quantitative analysis.

(ii) A practising analyst should, of course, be aware of the disastrous consequences on fusing silicon in platinum ware.

## An Accurate Report

(iii) The purpose of the reports of the Midlands Analytical Methods Discussion Group is to present an account of the meetings, *i.e.*, the introductory talk and the subsequent discussion. None of the points mentioned by Mr. Osborn was raised at the meeting in question and was not, therefore, included in the report. However, I again feel that an analyst actively engaged in silicon analysis would be aware of the well-known sources of error described by Mr. Osborn, although we are indebted to him for bringing up some of the problems involved. Many volumes have been written on the analysis of silicon-containing materials and it is obviously impossible to include everything about that subject in a few pages of the CHEMICAL AGE. Further, a false report would result if additional material were inserted by our reporter.

(iv) I do not consider that references should be included. Where possible, the year, when original research was published, is given, but surely Mr. Osborn has a poor opinion of the intelligence of his fellow analysts, since he seems to imply that they are not capable of tracing references to original work.

Finally, I should like to extend a sincere invitation to Mr. Osborn, and other analysts who may be interested, to become members of the Group. The secretary will be most

pleased to supply details. Some topics for future discussion are:—

'Ultra Micro Methods in Analytical Chemistry'.

'Analytical Control in Electroplating'.

'The Analytical Chemistry of the Alkaline Earths'.

Yours faithfully,

DR. A. J. NUTTEN.

Chemistry Department,  
Birmingham University.

[*Editor's note:—The secretary of the Group is W. T. Edwards, Esq., F.R.I.C., A.I.M., 100 Rymond Road, Ward End, Birmingham.*]

## Exploiting Own Resources

SCIENTISTS at the University of Saskatchewan are using three native Saskatchewan materials—sand, lignite coal and sodium sulphate—to produce soluble silicate, and a research project, sponsored for two years by the Saskatchewan Research Council, is being carried out by Dr. S. D. Cavers, professor of chemical engineering.

The scientists are seeking to produce soluble silicates by fusing sodium sulphate, available in large quantities in Saskatchewan, with silica and carbon. A series of small-scale tests has been made using temperatures from 900 to 1,200 degrees centigrade. In these first experiments, a commercial silica called Ottawa sand and commercial carbon black were used with the Saskatchewan sodium sulphate. Yields as high as 95 per cent soluble silicates have been obtained.

Now the researchers are seeking to use all Saskatchewan materials in the process. A pure sand, available in commercial quantities in the province, is being substituted for the Ottawa sand and lignite char, a material from Saskatchewan lignite coal, is replacing the commercial carbon black.

First tests indicate that these substitutions can be made without seriously affecting the yield of soluble silicates. However, further experiments are required before commercial production can become a reality.

## Wolfram Contract

The British Ministry of materials has contracted to purchase the greater part of the production of wolfram and tin of a group of mines at Panasqueira, Portugal, during the next two years. One-half of the materials is to be paid for at a fixed rate, and the other half at market price.

# Rubber in Chemical Engineering

## Specialised Uses for Synthetics

THE versatility of rubber and its allied products in all fields of chemical engineering was described by S. A. Brazier, O.B.E., M.Sc., F.R.I.C., of the Dunlop Rubber Company, in a paper presented to the North-Eastern Branch of the Institution of Chemical Engineers in Manchester on 10 November. The following is a fuller abstract of this paper than the one appearing in our issue of 17 November:—

Rubber is finding increasing application in chemical plant construction, partly because of the extensive range of special properties which can be developed in it, and partly because of the expansion of its practical applications now made available by the selective use of the allied synthetics and elastomers, and very largely because rubber linings form an economic alternative to special corrosion-resisting metals and alloys.

A number of the outstanding advantages of rubber are high resistance to wear and abrasion, and to tearing and cutting; ability to absorb shock and vibration; high resilience (*i.e.*, low hysteresis); high electrical resistance; protection against moisture; high chemical resistance, now increased by use of synthetics; limits in use with oil and solvents widened by use of synthetics; and good heat resistance.

### Adaptability Asset

Rubber has gained its place in the chemical industry because of its great adaptability. The so-called 'rubbers' used to produce rubber articles are compounds based on formulae worked out with scientific precision. Normally they contain a carefully controlled proportion of sulphur which, in conjunction with a percentage of organic or other accelerator, enables vulcanisation to be achieved within a suitable period of time. Vulcanisation, within the scope of this paper, can be considered as the effective combination of this rubber and sulphur, aided if necessary by the presence of a catalyst or 'accelerator of vulcanisation' by which the desired properties are built up, whether they be extreme resistance to wear, as in a tyre tread, or extreme resilience, as in elastic products such as the rubber strip used for billiard cushion, or durability as in rubber flooring.

These properties are, however, not wholly obtained by these means. The normal formulae for rubber compounds contain a number of solid ingredients, including carbon blacks, zinc oxide, china clays, silica, asbestos, barytes, carbonate of magnesia, and so on. These are added to give extra toughness, resistance to wear, or hardness or stiffness. Where chemical resistance is fundamental, it is obvious that materials such as zinc oxide, whiting and magnesium oxide will either be completely excluded, or used only in so far as they are necessary to give essential properties other than chemical resistance. Most modern formulae also contain some 'antioxidant' preservative to counteract deterioration through ageing.

### Use of 'Compounds'

The extent to which such specialised prescriptions, or 'compounds' as they are called, are used in modern rubber manufacture can be illustrated by the fact that in Dunlop's factory, some 4,000 different formulae are on the active list of the mill room where the compounds are mixed and in a normal week's running some 400 may be called into play.

Although most of these formulae are still based on natural rubber, manufacturers have not been slow to take advantage of the specialised properties of synthetic materials like neoprene, butyl, acrylonitrile copolymers, etc., and to use the related elastomers such as polyvinyl chloride, polythene, silicone rubber, etc.

After the rubber compound has been produced and prepared to the required thickness and shape, it is applied to the metal structure by the use of a suitable adhesive or combination of adhesives. The metal surfaces to be covered must be thoroughly cleaned by sweating in steam and decontaminated by shot-blasting or other appropriate methods. The rubber lining or covering is then submitted to some process of vulcanisation, which is essential to secure the complicated structural rearrangement by which the properties of the material are fixed.

Certain elastomers, such as PVC and 'Alkathene', do not require any vulcanising treatment. The selection of the adhesive will

be governed by the nature of the vulcanisation process used and the temperature to which the finished job will be subjected; but they are highly specialised preparations and usually regarded as factory 'secrets'; considerable progress has been made in this field in recent years.

#### Dry Spark Test

As a measure of protection, rubber linings are now almost universally subjected to a dry spark test after cure to detect pinholes or other paths to the metal. A high frequency low current discharge of the order of 20,000 volts and giving a spark of approximately 1½ in. long is usually employed.

The operator is using a long flexible wire as a probe, and the whole surface of the lining is searched for signs of weak seams, perforations or other defects likely to reduce the protective life of the lining.

Although this form of test has much to recommend it over the earlier electrolytic test, there are pitfalls to be considered. Soft rubbers and ebonites are extremely good insulators, and resistance of the order of  $10^{15}$  ohm./cm. can be obtained in the compound used for chemical plant work. A lining ¼ in. thick can therefore have considerable local reduction in thickness while still passing the spark test.

By careful use, however, a weakness or defect in the lining can be detected by a change in the colour and localisation of the spark when the probe approaches the defective area. It is within the author's experience that fissures or cracks so fine that acid will not penetrate to the metal, even after long periods, can be immediately detected by the intelligent application of this test.

Electrolytic tests used for enamelled equipment are not usually suitable for rubber linings.

The rubber industry has made marked progress in the type of lining which it can offer to the chemical engineer. Although many failures in the early days can be correctly assigned to inexperience or to the choice of an unsuitable material, more were caused by wrong design of the basic structure. The fact that the coefficient of expansion of ebonite is roughly five times that of steel, so that as it is a rigid material, any movement on the part of the metal during plant operation will set up a stress between the ebonite and the metal leading to premature failure, was often neglected.

Soft rubber linings are much more tolerant in this respect; it is therefore essential for ebonite or similar linings or coverings that a rigid metal structure should be used of sufficient strength to withstand distortion under internally applied pressure.

Concrete storage and process vessels are becoming increasingly common, many of them of very large size. This is a natural consequence of the great increase in the magnitude of heavy chemical plants. Considerable experience has been gained in the fixing of protective linings to these structures. Adhesives for both natural and synthetic rubbers are completely satisfactory. As far as can be foreseen there is virtually no limit to the size of concrete vessels that can be lined for the processing of chemicals. Design should allow of easy access for the operatives and avoid complicated changes of direction for the laying of rubber sheet.

Wooden tanks have been successfully lined with rubber. Hard, medium and soft woods properly seasoned, with low resin, absence of knot-holes and fairly straight grain have been used. The wood should be splinter-free and the construction close boarded. Any gap-filling agent or protective coating of paint or wood tar should be avoided without previous consultation with the rubber manufacturer. Wooden vats which have been in contact with liquors are apt to give rise to difficulties.

Given a good surface there is little limitation to the metals which can be suitably covered with rubber. For alloys rich in copper, however, it is advisable to tin the surface to prevent the direct contact of the rubber with the copper. With the use of iron a satisfactory bond can be obtained by steel shot blasting and spraying with a 60:40 brass at 1,800°F. Brass bonding techniques are used mainly for press-cured goods and there is a definite limitation to their practical use on larger plant.

#### Oxide Film Difficulty

Oxide films present some difficulty in aluminium bonding, and the treatment here involves fine shot-blasting followed by immediate application of priming adhesive, or alternatively for small items pickling in inhibited dilute hydrochloric acid and then washing.

From the point of view of chemical resistance ebonite is superior to soft rubber and is to be preferred where chemical conditions



are severe. Full chemical and heat resistance, however, can be often obtained only at the expense of some flexibility. It must also be remembered that ebonite is a thermoplastic material and softens at temperatures from 60-70°C.; working temperatures generally should, therefore, not exceed 70°C. even where the ebonite is supported by metal; but these are general statements, and must be considered in relation to actual conditions and the life relative to that of alternative materials.

For all purposes where non-staining and non-tasting rubbers are required, as for instance in the handling of vinegar and other food liquors, ebonite is generally to be preferred.

Soft vulcanised rubbers are to be recommended for conditions where resistance to cutting and abrasion are important and where temperatures are high or undergo marked changes.

In certain structures, such as pickling vats, it has been found advantageous after lining with rubber to construct a further inner lining of brick or tile. This serves as a protection against abrasion or other mechanical damage, and also increases the temperature gradient between the rubber and the liquor.

In recent years developments in the application of synthetic elastomers to chemical plant have greatly extended the scope of the rubber manufacturer in this field.

(i) *Neoprene*. It is often difficult to develop suitable technical properties in natural rubber, combined with adequate resistance to traces of oils or solvents. Extensive use has therefore been made of neoprene or polymerised chloroprene since its introduction by the Du Pont Company of America in 1929.

#### Neoprene Superior

Neoprene is superior to natural rubber in its resistance to oils, heat, oxygen and sunlight exposure. Although slight swelling is encountered with animal, vegetable and petroleum-base products, this has little effect on its physical properties; nor does it dissolve, become gummy or slough off.

In general it can be used in contact with inorganic chemicals, and strong alkalis can be successfully handled although it is not recommended for ammonia. Resistance to copper salts is much superior to that of natural rubber provided suitable antioxi-

dants are incorporated. It is resistant to many organic materials, especially to the more highly saturated aromatic compounds, although it is not suitable for use in contact with chlorinated hydrocarbons and shows rapid swelling with aromatic solvents such as benzene.

(ii) *Butyl*. Butyl rubber was introduced in 1937. It is an interpolymer of isobutylene with a small percentage of isoprene to give controlled unsaturation. It has an extensibility within the same range as that of natural rubber. Resilience and abrasion properties are lower, although tear-resistance and flexibility are equivalent to those of rubber at low temperatures. It is, however, temperature sensitive and resilience increases with temperature rise. Impermeability to gases is exceptionally high and water absorption is low, being about 2 per cent by weight as compared to 25-40 per cent for natural rubber.

#### Resistance of Butyl

For chemical plant work the outstanding feature of butyl is high chemical resistance. It is superior to rubber in handling pickling liquors containing hydrofluoric and nitric acids in low concentrations. It also has good resistance to copper salts, and can be used with certain organic nitro and amino derivatives and solvents such as ethers, alcohols and esters.

Butyl can be used in all forms of chemical plant where natural rubber has previously been employed. Except for conditions where resistance to abrasion is important its service would be equivalent, and for some conditions a considerably longer life can be obtained by its use. It can be satisfactorily applied to mild steel, wrought iron, low porosity cast iron and aluminium alloys.

Its general chemical resistance is similar to that of neoprene, but the latter has an advantage if traces of oil or equivalent solvents are encountered in addition to the primary chemicals present.

(iii) *PVC*. Marked advantages of plasticised polyvinyl chloride linings and coverings for chemical plant under some conditions are now becoming generally recognised, especially for processes involving the use of acids or strong hypochlorites. Nitric, chromic and hydrofluoric acids can be handled at temperatures up to 60°C., in concentrations which would have a severely deleterious effect on natural rubber. Tanks

for the immersion pickling of stainless steels, in which nitric and hydrofluoric acid mixtures are used at 60°C., have given satisfactory service, and linings have remained essentially unaffected by solutions of chromic acid used in the chromium plating process.

#### Other Uses of PVC

Although originally employed as an acid-resisting material, PVC can also withstand prolonged contact with such plant liquors as sodium hydroxide, strong commercial sodium hypochlorite and hydrogen peroxide, and has been successfully used for bleach liquors containing relatively high percentages of available chlorine, where it has given a considerably longer service life than special type ebonites previously used for this purpose. It has also been used in plant for copper plate engraving and in the fat-splitting process where grease and acid are encountered together.

The rigid unplasticised type of PVC can be used for unsupported pipings and fittings for the conveyance of plant liquors at low pressures and temperatures. It can be machined to fine limits using drills, lathes or other conventional equipment. Sheet, rod, and tube can be used in building up to the required design, joints being welded with hot air torches and welding rows. Shaping is done by heating to 120°C. and cooling on insulated formers of wood or laminated plastic to avoid pronounced chilling. The welding is a skilled operation as the margin between shaping and fusion temperatures is slight.

PVC linings have high electrical resistivity and have good resistance to water, sunlight and gas diffusion. Lining is carried out at normal temperatures and so does not require special equipment for vulcanisation.

Work can be done on site; no curing is necessary and the tanks can generally be used within three days after lining.

(iv) *Silicone rubber.* Silicone rubber is an organo-silicone polymer with heat resistance over an unusually wide temperature range. As the compound has no chemical unsaturation it does not respond to the usual sulphur vulcanisation methods of organic rubbers, and while the special 'curing' techniques used can give a limited variety of characteristics in the finished material, the modifications which can be obtained by compounding are not so extensive

as with other materials used by the rubber manufacturer.

Although at normal temperatures physical properties are not so good as those obtained with natural rubber, they become relatively superior at extreme temperatures. Flexibility and elasticity are retained at temperatures as low as minus 70°F., and are only slightly impaired after 20 hours' exposure at 572°F.

In spite of fairly good oil-resistance, general chemical resistance is not high; considerable swelling is caused by solvents such as benzene, toluene, petrol and carbon tetrachloride, but the original properties are regained as the solvent evaporates.

Electrical insulation is similar to that of rubber, with the advantage that dielectric strength is maintained from minus 60°F. to over 300°F. There is complete freedom from arcing and tracking and excellent resistance to corona attack and ozone. Silicone rubber has, therefore, found a number of uses for wire covering and general insulation purposes in the electrical, aircraft and radio fields. Other applications include gaskets, seals, packings and miscellaneous machinery components for temperature conditions unsuitable for natural rubber.

Work on silicone rubber has hitherto been somewhat restricted by the high price and limited supply of the raw material available, and it is hoped that the recent decision to manufacture in this country will enable an expansion in its development and application to industrial purposes.

#### Rubber Different

Rubber departs from the normal conception of the requirements of an 'engineering material.' The structure of engineering science is based on the behaviour of a number of materials having constant and reliable properties which can be listed, and the basic data so obtained used to calculate their behaviour under varying conditions of stress, temperature, and so on. Rubber does not obey many of the laws which apply to solids or liquids generally.

It is, however, by nature of these departures from normal laws that rubber is enabled to fulfil many of its important industrial applications, and a most useful purpose will have been achieved if the need for close co-operation between the chemical engineer as user and the rubber manufacturer as producer has been demonstrated.



# Ethyl Silicate in Industry

by A. E. WILLIAMS, Ph.D., F.C.S.

ALTHOUGH ethyl orthosilicate ( $C_2H_5)_2SiO_4$ , was discovered by Wurtz in 1863, it is only in recent years that it has found extensive use in industry. It is obtained by the action of silicon tetrachloride,  $SiCl_4$ , on anhydrous alcohol. In the presence of water, hydrolysis of the ethyl silicate occurs with the formation of orthosilicic acid and alcohol, thus:  $(C_2H_5)_2SiO_4 + 4 H_2O = H_4SiO_4 + 4 C_2H_5OH$ . Ethyl silicate is a colourless, mobile liquid boiling at about  $170^\circ C$ . at atmospheric pressure, or at about  $62^\circ C$ . under 12 mm. pressure. It has a flash point of approximately  $53^\circ C$ ., is insoluble in water, but is soluble in many organic solvents.

Ability of ethyl silicate to undergo many modified forms of hydrolysis in the presence of suitable reagents forms the basis of its industrial applications. These include the use of hydrolysed solutions for the protection of metals, coating of concrete, asbestos cement sheet and stone, as a binder for powders, and for the manufacture of acid-resisting mortar. Its application as a bonding material for refractory powders has made possible the construction, by simple methods of moulding, of numerous types of heat-resisting units.

## Application in Metal Protection

In the sphere of metal protection ethyl silicate has been used successfully as a medium by which to deposit silica in the pore structure of sprayed metal and thereby produce a heat-resistant coating. It has been particularly applied to aluminising processes for the coating of steel. In the normal aluminising procedure a coating of aluminium is sprayed on the steel surface and so treated that an iron-aluminium alloy is formed on the surface of the steel, the alloy being considered to be  $FeAl$ . A feature of the aluminising process is to prevent oxidation of the aluminium before the necessary diffusion layer of metal has been formed.

In the past, oxidation has been prevented by the application of such materials as sodium silicate, borax, or a coating of bituminous paint. Not only does the use of ethyl silicate avoid these standard types of protection, but it also renders the furnacing

of the aluminium-coated work unnecessary. The sprayed coating of aluminium may be treated directly with a partially hydrolysed solution of ethyl silicate and this results in silica being precipitated into the pores of the sprayed coating. A solution for this purpose may be prepared as follows: 80 parts, by volume, industrial alcohol are mixed with 16 parts of 0.1 per cent hydrochloric acid and 170 parts ethyl silicate; the solution is well mixed and then allowed to stand for about 30 minutes, at the end of which a further 170 parts ethyl silicate is added. This mixture is prepared only in amounts that can be used within the next few days, since it starts to decompose after about 48 hours.

## Use in Aluminising Processes

Use of ethyl silicate in the aluminising processes, it is claimed, prevents superficial oxidation of the aluminium at elevated temperatures and the presence of the silica appears to aid the formation of the necessary alloy layer.

Mixtures of ethyl silicate, industrial alcohol and water in certain proportions are heterogeneous, but prolonged stirring of the mixture in the presence of a small proportion of acid brings about the slow hydrolysis of ethyl silicate, and condensed ethyl silicates with alcohol are liberated. Because of this, the proportion of alcohol present gradually increases until it attains such a proportion as to render the mixture homogeneous. It is possible to prepare hydrolysed solutions of this type and these gradually increase in viscosity until they assume a gel-like character. This process of gel-formation is accelerated when the solution is left freely exposed to the atmosphere, which results in loss of solvent.

The gelling process, when necessary, can be speeded up even more quickly by the addition of small proportions of an alkali after the solution has become homogeneous. The resulting product consists of silica and condensed ethyl silicates and in this state is an excellent bonding agent for many types of powdered and granular substances.

In preparing hydrolysed ethyl silicates for bonding purposes, the proportions of ethyl silicate, alcohol and water may be varied

over a wide range, and in some cases the proportion of alcohol is increased, while the water content is reduced, to obtain within a short time a homogeneous mixture. The main object of the acid addition is to reduce the period necessary to attain a homogeneous mixture, but, in general, the higher the proportion of acid used, the shorter becomes the storage life.

#### Bonding Agent Properties

When ethyl silicate is prepared as a bonding agent it has the property of depositing extremely fine silica among powdered refractory materials. By using a suitable mix it is possible to construct numerous items of plant which have to withstand elevated temperatures. Some of the components now made in this way include interiors for gas, electric or oil fired furnaces; liners and formers for electric muffle furnaces; insulators, sleeves, and inserts for low frequency coils; burner blocks and element-retaining bricks; tubes for high temperature furnaces working in inert atmospheres; numerous types of crucibles; saggars to suit furnace or kiln apertures; suspension rods, furnace nozzles and orifices; pre-formed linings for furnaces; crucibles, circular muffles and open melting hearths for assay work; pouring orifices, and so on, for the glass industry; prototypes for many descriptions covering new designs or components for laboratories, research establishments and industrial undertakings; and top secret work on atomic energy, rocket and jet plane design.

An example of work made by moulding processes in which ethyl silicate is used as the bonding agent is a hollow spiral worm for a flue, 7.5 ft. high by 2 ft. overall diameter, which is used as an experimental tunnel by the British Coal Utilisation Research Association.

The process of bonding the various refractory materials together to make the moulding material is known as the sil ester bonding process, and ethyl silicate normally takes the place of older, and less efficient bonding materials such as clays and fluxes. In producing moulded goods, the technique follows closely that of the well-established methods for the production of pre-formed units, and any shape can be produced provided a mould, of wood or other material, can be made to that shape. The advantage of ethyl silicate as a bonding agent is that it allows silica to cover each particle of the

powdered refractory materials used and it yields the silica in a very reactive and adhesive form.

One method of preparing a hydrolysed solution of ethyl silicate for the bonding of refractory powders, as well as for painting on concrete, asbestos cement sheet, and stone, to preserve their surfaces, is as follows; 800 ml. industrial alcohol, 300 ml. dilute hydrochloric acid of 0.06 per cent strength, and 1,900 ml. ethyl silicate are shaken and stirred until the liquid does not separate into two layers; hydrolysis is then complete. About an hour later, 1500 ml. ethyl silicate are added.

Among the established uses of hydrolysed ethyl silicate is that of the preservation of decaying stonework, as often found in old buildings. The ethyl silicate increases the resistance of the stone to climatic conditions, for it penetrates the pores of the stone and the solution sets to a jelly which eventually dries to a hard gel and binds the particles of decayed stone.

#### Porous Substances Strengthened

Many porous substances such as asbestos, paper, cork and textiles can be impregnated with ethyl silicate solutions and thus be strengthened, hardened or stiffened by deposited silica and condensed silicates. A paint medium containing the most suitable proportions of silica and condensed silicates has been developed. The coatings based on ethyl silicate are non-combustible when dry and may be used to coat all types of fabrics to minimise danger from fire. Reduced inflammability is similarly produced when ethyl silicate is admixed with plastics used for surface coatings. One interesting application is as a bond for the pigment used in the graduation marks on thermometers; this filling material is resistant to attack by most chemicals, but particularly to hydrocarbon vapours.

Since the ultimate product from the hydrolysis of ethyl silicate is silica, it might be thought that silicosis dangers would be likely to attend its use. Experiments on animals exposed to tetraethyl silicate vapours, followed by micropathological investigations, have caused this idea to be rejected. The toxicity of ethyl silicate is not regarded as high compared with other toxic vapours, and in any case its low vapour pressure makes the formation of injurious concentrations unlikely.

# Underground Oil Storage on Water Beds

## Swedish Research Successful

WHAT kind of chemical reaction would take place, if any, were petrol and heavy oil to be stored underground on a water bed, was one of the problems confronting Mr. Harald Edholm, Purchasing Director of the Swedish Power Board when, a few years ago, he began tests and research into these possibilities.

The main idea behind these tests was to find sufficient space for storing the large quantities of fuel oil needed for the steam plants of the Power Board.

At first small-scale experiments were made and these convinced Mr. Edholm that such a scheme was possible and that old feldspar mines would make admirable reservoirs where the pressure of subsoil water would act as an effective caulking medium and prevent the oil from escaping through cracks in the rocks.

### Extensive Tests

During the past few years extensive tests have been carried out on these lines and detailed results have just been released which claim to be entirely satisfactory. So much so that Mr. Edholm, in co-operation with a well-known Swedish contracting firm, Svenska Vågaktiebolaget, is now exploiting the method under the patented name of Viaco Cistern.

Among the advantages reported to be derived from this storage method for heavy oil is the fact that it retains its heat and viscosity much longer than when stored in an ordinary steel tank. A thermometric system which makes it possible to read the temperature of the oil at 32 different levels at a central point has been evolved and this shows that the temperature of the bottom layer gradually rises from 0°C. to +5°C. and that the upper layers which receive the oil at a temperature of +30°C. to 35°C. lose the heat very slowly and the temperature does not fall below +15°C. even after long storage. This means that the oil needs very little warming at the time it is taken out.

Also the warm oil largely cleans itself from water and impurities, which gradually sink to the bottom, and cleaning the usual filters fitted before the pumps has so far been found unnecessary. Indeed, tests have shown that the water content of the oil

taken out of the mine is lower than that of the oil put in. Water pumped out of the bed of the mine has a slight smell of chemicals but contains no oil and when this water has been discharged into the nearby bay no coating of oil has been observed.

Further experiments with petrol are claimed to have been equally successful and there has been complete absence of leakage and evaporation. This combination of petrol and water, hitherto regarded as impossible, also seems to solve the problem of storing petrol and light oils for an indefinite period.

Samples of the petrol taken from the cistern after four months storage have been tested and analysed by the large Swedish Nyäs Refinery with very satisfactory results. Whereas a control sample of the petrol taken at the time of delivery and kept in a dark room had yellowed in the usual way, that from the water-bed cistern was still as clear as water. According to the special scale used for such tests it was found that the colour of the rock-stored sample had actually improved from 2.5 to 1.25 units. It is explained that the subsoil water acts as a purifying agent as it drips through the petrol and absorbs some of the resins and sulphur. Comparative investigations also show that the water content and resins have otherwise remained unchanged as also have the distillation curves and steam pressure.

The advantages of this method of storage in the event of war are obvious, while the saving of steel plate for tanks under present conditions adds to the attraction of rock-storage.

The installation of a number of Viaco Cisterns is at present under consideration both in Sweden and abroad and the patentees and the contractors are now completing a large petrol storing plant ordered by the Swedish authorities.

### Turkey Bans Sulphur Exports

The Turkish Government has recently placed a ban on sulphur exports from that country, it is reported. During the period March-May, 1951, Turkey exported about 1,500 metric tons of the element to Britain, India and the Netherlands.

## Bubble Plate Efficiency

### A.I.Ch.E. Research Programme

RESEARCH in chemical engineering on complex problems outside the scope of usual research programmes is being planned by the American Institute of Chemical Engineers, according to a recent announcement made in New York by officials of the group. The announcement was based on a progress report by Walter E. Lobo, chairman of the Research Committee of the American Institute of Chemical Engineers, and director of the chemical engineering division of the M. W. Kellogg Company. There it was stated that 'bubble plate efficiency' was the subject which could be studied with the most value in the research programme fostered by the A.I.Ch.E. Bubble plates are important components of distillation towers, used in the chemical, petroleum, and other process industries, and their efficiency greatly affects yields and cost of products. According to Mr. Lobo, the committee has made a survey of all research institutions to determine interest, experience, facilities, and man-power to undertake this study, and three universities have been recommended to carry out various phases of the over-all programme.

The Research Committee was appointed in July, 1950, 'to foster research projects in chemical engineering which by their scope, complexity, or general nature, were such that no single institution or company could afford to institute a comprehensive planned research programme.'

### Of Wide Interest

It was the aim of the Institute in forming this committee to choose projects of broad interest which would attract the interest of many large and small industrial concerns.

The committee has been studying the necessity of a research programme in bubble plate efficiency since then, and has developed a basic programme of research on the effect of tray design and system properties on tray efficiency both in fractionation and absorption.

According to Mr. Lobo the programme, as it is now set up, calls for variations in column size and tray spacing with a wide range of operating pressures and systems. This will permit 'thorough evaluation of the individual effect of the gas and liquid phases on the efficiency of separation'. 'If the

programme is accepted,' said Mr. Lobo, 'this will be the first time that such a comprehensive study was undertaken in chemical engineering, and the results will be beneficial to all industries in the chemical process field'.

Activation of the experimental work now awaits only final approval of the Research Committee budget by the Council and active solicitation of funds.

## Control of Glasshouse Pests

ATTACKS by pests and foliage diseases of glasshouse crops are frequently most severe when food and flowers are due for marketing and thereby cause special problems in connection with their control.

Developments in materials and methods of application, particularly in respect of insecticides, were reviewed in a paper 'Chemical Control of Glasshouse Pests and Diseases,' read by W. H. Read, head of the Insecticide and Fungicide Department, Experimental and Research Station, Cheshunt, Herts, to a meeting of the Crop Protection Panel of the Agricultural Group of the Society of Chemical Industry, held in London on Tuesday last (4 December).

Methods and materials employed in other countries were referred to by the speaker, who showed the tendency to distribute insecticides in 'aerosols' and 'smokes' was replacing the conventional spraying.

Insecticides recently introduced had proved of great value for the control of pests of commercial glasshouse crops and had replaced most substances used eight years ago. Mixtures of azobenzene and parathion were used widely for the control of the glasshouse red spider and the results of investigations on other acaricides were mentioned, as were problems of increased tolerance to insecticides by insect populations. Some mention was made of the use of systemic insecticides.

Copper-petroleum emulsion sprays had not been replaced by any of the newer fungicides, few of which had been found satisfactory for the control of the most important foliage diseases.

Use of thiocarbamates for some minor diseases was mentioned together with a brief résumé of recent glasshouse trials of fungicides. Possible developments in the partial sterilisation of soil with volatile chemicals were also referred to.

## Bismuth in Human Teeth

### Cathodo-Luminescent Analysis

THE presence of bismuth as a trace element in human teeth and in fish bones has been confirmed by the cathodo-luminescence method of analysis at the Tohoku University, Sendai, Japan. The specimens of bone or tooth were washed, dried and heated at 950°C. for two hours, it is reported, and excited with cathode rays. The different colours of luminescence indicated the presence of various trace elements behaving as activants, with calcium triphosphate as the luminophoric base.

The intense bright red luminescence was found to be due to the  $\text{Ca}_3(\text{PO}_4)_2\text{-Bi}$  phosphor, for the following reasons: (1) boiling the specimens for more than 12 hours with 5 per cent NaCl or 1 per cent KOH at the beginning, produced only a very faint blue luminescence, even when treated subsequently in the manner mentioned above; and boiling for more than 12 hours in  $\text{CHCl}_3$  or water did not alter the red luminescence.

(2) Pure calcium triphosphate heated at 950°C. for two hours produced only faint blue luminescence, until Bi was added in the ratio  $10^{-6}$ : 1 and the heating repeated, when the bright red colour appeared.

(3) Bismuth was detected in the NaCl extract in (1), and when a solution containing Bi was concentrated from fish bones and a drop added to the specimen in (1), red luminescence resulted. This solution also gave the well-known violet-blue luminescence of the  $\text{CaS-Bi}$  phosphor.

(4) Adding Bi chemically to the specimen in (1) in the ratio  $10^{-6}$ : 1 again gave the red luminescence.

Human teeth showed the same behaviour when subjected to the above treatments, although a decayed tooth did not show red luminescence at all.

## Documentation in Rubber

ON 19-20 November a discussion was held at Delft, Holland, on the international documentation of literature and patents on rubber. The discussion was held between organisations of the producers of natural rubber and the Research Association of British Rubber Manufacturers.

The meeting unanimously welcomed the excellent system of documentation which had already been evolved for the British rubber industry by the Research Associa-

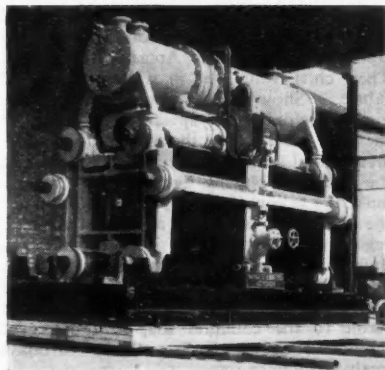
tion of British Rubber Manufacturers (the so-called Dawson system), and adapted to the requirements of the French rubber industry by the Institut Français du Caoutchouc. It was agreed that efforts should be made to adapt this system to the needs of the plantation industry and that the producers' organisations should, in turn, assist in collecting and abstracting information.

## Not Revolutionary

IN our issue of 17 November, on page 676, we published a short item headed 'A New Electrolyser' which announced that the Montecatini Company had constructed one of these plants of the filter-press type in Italy for the production of hydrogen. In this report it was said that the firm were testing a non-metallic cell frame 'which may represent a revolutionary step in the field of hydrogen-producing electrolysis plants'.

This statement has been challenged and it has been drawn to our attention that Bamag, Ltd., the largest manufacturers of filter-press type electrolysis in Great Britain, have been using non-metallic cell frames for their small and medium size electrolysis for almost 10 years. Plants of this type have been installed by the firm in countries ranging from India to Iceland and approximately 20 of them are in operation all over the world.

The photograph is of Bamag type AB50 electrolysis assembled at the works prior to dispatch. It was taken in 1947 and since then considerable stream-lining has been achieved and various improvements in the internal construction have been incorporated.



## • OVERSEAS •

### Colombian Fertiliser Plant

It is proposed to set up a plant for the manufacture of nitrate fertiliser and ammonia in the Barrancabermeja district of Colombia. The Caja Agraria, Banco de la Republica, National Coffee Federation, Agriculturists' Society, Rice Growers' Federation and Institution for Cotton Development, are interested in the scheme, as well as the National Government, and the plans have been made by the Chemical Construction Corporation, a U.S. concern. The raw materials to be employed will be coal and natural gas. The cost of the plant is calculated at some 11 million pesos.

### New Solvent in Production

Dimethoxy tetraethylene glycol, a colourless high-boiling ether with the valuable property of being miscible with both water and organic solvents such as toluene, benzene, ethanol, diethyl ether, etc., is now available in single drum quantities in America. Soon the Eureka Williams Corporation, who have licensed production of the chemical, hope to have larger quantities available. Having no active hydrogen in the molecule, dimethoxy tetraethylene glycol makes a very useful medium for Grignard and sodium condensation reactions. As a selective solvent it has been used to purify such gases as acetylene and sulphur dioxide, report the company.

### Fluorescent Dyes Whiten Fabrics

Colourless, fluorescent, direct dyestuffs recently developed by the General Aniline & Film Corporation of America are the compounds known as Antara Brighteners. Their chief value lies in whitening washed fabric. Showing no absorption in the visible region of the spectrum, but only in the near ultra-violet, these dyes do not decrease total surface reflection of a cloth like the ordinary blueing agents, which merely mask the yellow in cloths, but add to it since the ultra-violet is emitted as light in the blue region of the spectrum, and treated fabric thus exhibits a blue fluorescence. These dyes can be added at any final stage in detergent processing, and are said to be stable to the common soap and detergent builders such as alkalis, starch, carboxyl methyl cellulose, etc.

### U.S. Coal Reserves

Estimated coal reserves of the U.S., recently released in a publication of the U.S. Geological Survey, are 1.2 million million tons of potentially recoverable coal. Of this, about 50 per cent is bituminous coal, 19 per cent sub-bituminous, 30 per cent lignite and 1 per cent anthracite. About 30 per cent of the total has been classed as being in beds at least 28 in. thick and not more than 2,000 ft. deep—the present limit for economic mining. Improved mining methods, however, and other means of recovery such as underground gasification, may increase the percentage of 'economic' coal in time. All these coal reserves are privately owned, and look like staying so, and they are all located within U.S. borders, eliminating any foreign cartel influences.

### Japanese DDT in Korea

The Nippon Soda Company of Tokyo, largest of eight DDT producers in Japan, are co-operating with United Nations forces in Korea by supplying them with DDT, it is reported. They hope to increase their DDT production this year.

### Fatter American Pigs

Terramycin, the antibiotic drug which was found to speed the rate of growth of chickens and hogs, has lately been incorporated in the U.S. into a new milk for piglets, which is said to make them ready for market 40 days before ordinary pigs. The discovery of this new synthetic milk, called 'terralac', which contains, besides terramycin, skimmed cow's milk, extra fat, and vitamins, has been announced by Mr. H. G. Luther, of Charles Pfizer & Company. It is claimed to decrease the infant mortality rate in pigs. The young piglets are taken from their mothers 24 hours after birth and put in specially heated brooders like those used for chicks. Recorded grunts from the mother and the recorded sound of small pigs eating is relayed to them to encourage them to eat 'terralac'. Mortality in 3,000 piglets treated thus was said to be a mere 5 per cent compared with 20-30 per cent normally. Effect, if any, on human beings of 'terralac'-fattened pigs is not reported.



## PERSONAL

MR. D. GORDON (a Plastics Division joint managing director) retired on 30 November after nearly 38 years' service with I.C.I. and its predecessors.

Mr. Gordon joined The New Explosives Co., Ltd., in 1914. In 1927 he was appointed assistant secretary, and later accountant, of Nobel Chemical Finishes, Ltd.; he became a delegate director of that company in 1936. In 1943 he was appointed a joint managing director of I.C.I. (Lime), Ltd., and became a Plastics Division managing director in 1945.

The Sulphur Exploration Syndicate formed by the leading chemical manufacturers to explore new sources of sulphur, has appointed as chief executive, Major General G. E. Wildman-Lushington, C.B., C.B.E., R.M. (Retd.).

General Wildman-Lushington will be operating from offices in Ivy House, Newgate Street, London, E.C.1. He was chief of Combined Operations 1947-50 and Chief of Staff to Chief of Combined Operations 1942-43. In 1945 he was G.O.C. Commando Group.

The Fulmer Research Institute of Stoke Poges, Bucks, announce that SIR DAVID BRUNT, M.A. Sc.D., F.R.S., has been appointed to the board of directors of the Institute.

Sir David has been Professor of Meteorology in the University of London, at the Imperial College of Science and Technology, South Kensington, since 1934, and is vice-president and secretary (physical) of the Royal Society.

The Institute was founded in 1946 on the initiative of COLONEL W. C. DEVEREUX, C.B.E., the chairman, and opened officially by Sir Stafford Cripps, then President of the Board of Trade in July, 1947. Its objects are to carry out sponsored research, the results arising therefrom (including patents) belonging solely to the sponsors.

COMMANDER (E) T. J. TURNER, R.N. ret., A.M.I.Mech.E., has been appointed general manager of Prat-Daniel (Stanmore), Ltd., makers of fans and dust collectors, as from 1 November, 1951.

MR. S. R. HALSEY, who has been twenty years with Messrs. James Gordon & Co., Ltd., makers of automatic boiler control instruments, etc., has now been appointed a director of the company.

Newly appointed as manager of Shell Haven (Essex) refinery is MR. JAMES GRANT, who for the past year has been assistant manager of Shell's other full-scale U.K. refinery at Stanlow in Cheshire.



Mr. J. Grant

Mr. Grant, aged 51, was born in Edinburgh and educated at George Heriot's School and Heriot Watt College. Starting his career as an oil chemist, he joined Shell in 1927 and spent his first eleven years' service in the U.S.A.

Early in 1938 Mr. Grant was transferred to Suez as assistant refinery manager, remaining there until November, 1940. Soon after his return to England he became superintendent at the Stanlow refinery.

In 1944 he went to Trinidad as an assistant refinery manager and was later promoted to assistant general manager in that area, a post which he held until his return to Stanlow in October, 1950.

MR. R. W. J. SMITH, whom Mr. Grant succeeds, has returned to a head office appointment in London.

### Canadian Sulphur

Speaking before the Canadian Institute of Mining and Metallurgy in Montreal on 30 November an official of the Department of Defence Production said that by the end of next year it was expected that Canada would have a new capacity equivalent to 120,000 long tons of sulphur per year.

Of this, 50,000 tons would be from smelter gases, 50,000 tons from the burning of pyrites and 20,000 tons from natural gas.



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## HOME

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### Change of Ownership

Wm. Burton & Sons (Bethnal Green), Ltd., announces that from 1 December, 1951, its works passed into the ownership of Laporte Chemicals, Ltd., of which it was a subsidiary company. The step has been taken to improve administration of the group. Orders and inquiries should in future be addressed to the head office of Laporte Chemicals, Ltd., 14 Hanover Square, London, W.1 (Telephone: MAY-fair 6001). Accounts will, however, be rendered from and paid to the office at Luton, Beds. The staff at Bethnal Green is being retained by Laporte.

### Midlands Discussion Group

The next meeting of the Midlands Analytical Methods Discussion Group will be held on Tuesday, 11 December, at 7 p.m. in the large lecture theatre, Chemistry Department, The University, Edgbaston, Birmingham, when two short papers will be contributed under the general title, 'New Methods in Electrometric Analysis.'

The speakers and their subjects on this occasion will be:—

1. 'Analysis at Controlled Potentials'—G. W. C. Milner, M.Sc., F.R.I.C., and R. N. Whittem, B.Sc.
2. 'Advances in Polarography'—J. E. B. Randles, B.A., B.Sc.

The opportunity to learn something of the possibilities of these important new techniques in analytical chemistry is one which the committee feels will be welcomed by all members.

The change in meeting place has been made in order to meet the request of the speakers for facilities to illustrate their talks by working demonstrations.

### Metal Powder Fire

Five men were injured, one seriously, in an explosion which followed a fire at a works where powder is prepared for use in fire-works and paint manufacture at Bolton, on 30 November. It occurred in a one-storey building where aluminium powder is ground in premises jointly occupied by Wolstenholme Bronze Powders, Ltd., and British Metal Powders, Ltd., Springfield Road, Duns-car.

### More Titanium Needed

Need for quicker production of titanium in Great Britain was stressed by H. H. Gardner in a paper on 'Structural Problems of Advanced Aircraft,' delivered to the Royal Aeronautical Society on 29 November. Titanium, said Mr. Gardner, was the most important, at present, of the new materials, and investigation of methods of fabrication should be given high priority. Its ability to withstand high temperatures, low specific weight, weldability and resistance to corrosion made it extremely suitable for the jet-engine.

### Tribute to British Firm

Recognition of the high standards achieved by the British firm Johnson, Matthey & Co., Ltd., was made recently by the Technical Information Division of the United States Atomic Energy Commission at Oak Ridge, Tennessee, in a publication 'Availability and Sources of the 96 Elements in High Purity Forms (URCL-266).' The author, Elwin H. Covey, of the University of California, stressed the importance of such materials in modern research and the scarcity of information on purity and form. The present list was an endeavour to clarify this problem. Compounds and metals were listed in order of decreasing order and in his foreword Mr. Covey stated: 'Johnson, Matthey & Company generally heads each list. This company's products serve as reference points to indicate the most reliable high purity material generally available. Other materials and sources may be judged relative to this company with its products as standards.'

### Catalogue Library

The Engineering Centre, 351 Sauchiehall Street, Glasgow, C.2, has now opened a Catalogue Library which contains the literature of more than 3,000 firms, and also a complete set of British Standards. Frequent additions by the firms concerned, and constant supervision by their own technical staff, ensure that the library contains only the most recent publications.

Manufacturers who have not included the Centre's name on their mailing lists for publicity matter, are invited to do so.



## The Chemist's Bookshelf

**A GUIDE TO PLASTICS.** By C. A. Redfarn.  
Published for *British Plastics* by Iliffe  
& Sons, Ltd., London. 1951. Pp. 112.  
7s. 6d.

A further recruit to the ever increasing army of books about plastics, this is a small non-technical introduction to the subject intended mainly to be read by the student and the layman or omnivorous reader. The first chapter of the book is concerned with explaining the nomenclature of plastics and the technical terms used in describing them. In this section there is the surprising statement that 'phenol, formaldehyde, urea, melamine, vinyl acetate, methyl methacrylate, ethylene, adipic acid and hexamethylene tetramine are called monomers'. While this is of course perfectly true, the assumption is that each of these materials can form a polymer in the same way. It is a confusing over-simplification to modify this later on by saying that one or two of these monomers are combined together to give polymers. It would have been simpler at this stage to confine the readers' attention to substances like styrene which can illustrate the terms quite adequately, and to introduce the formation of large molecules by condensation at a later part of the book.

I found the coloured diagrams, printed rather drably in two jarring shades of red and blue, dull and uninteresting to look at, although quite efficient as information summaries. A more inspired treatment with small diagram pictures replacing the blocks, and brighter and more sympathetic colours would have made these important adjuncts to the text far more appealing to the lay reader.

The second section of the book deals with the manufacture of plastic materials, and this section contains excellent summaries of the production processes. These are given without any chemical formulæ to explain them, and while this is probably an advantage for the layman, the student will be conscious of this omission. In the description of casein plastics there was a welcome reference to the 'milk for plastics' contro-

versy. One of the rumours that never seem to die and indeed grow in stature during the seasonal milk shortages, is that fresh milk, which should be available as food, is being manufactured into casein plastics for umbrella handles and other trifles. The author states the case for the plastics industry fairly but firmly, showing that most of the raw material is imported as casein.

The fabrication of plastics is discussed in a succeeding chapter and this is one of the most interesting in the book. The processes are explained very simply and clearly and there are a number of excellent explanatory diagrams.

A short final chapter gives a brief account of the properties of plastics, and this is written in a critical fashion, attention being drawn to the defects and limitations of the materials as well as to their advantages. The book is well indexed and can be thoroughly recommended as an intelligent and unbiased introduction to the subject.—J.R.M.

**DIE ATHERISCHEN ÖLE.** By R. Leimbach.  
In German. Second edition. 1951.  
Paper covers. Pp. 271. Dm. 11.

This businesslike little book gives a description of the origin, production, purification, properties, composition and examination of essential oils. Every essential oil is generally described in the following order: (1) Latin classification, (2) name of oil, (3) original plant, (4) country of cultivation, (5) country of production, (6) methods of preparation, (7) properties, (8) established components, (9) uses and literature. It also gives details of the application of individual essential oils in perfumery, soapmaking, cosmetics, the food industry, medicine, etc.

A good deal of the information in this book is based on publications of the largest German essential oil makers, and on a couple of the larger German textbooks.

In spite of its faults *Die Atherischen Öle* is a useful concise reference book which should be of value to anybody who has occasionally to make a quick check on a sample of an essential oil.—S.P.S.

## Law & Company News

### Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

#### Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an \*—followed by the date of the Summary, but such total may have been reduced.)

**HILGER & WATTS, LTD.,** London, S.E., scientific instrument makers. (M., 1/12/51). 17 October, £100,000 debenture stock and a premium of 1 per cent in certain events secured by a Trust Deed dated 10 October, 1951 (supplemental to a Trust Deed dated 12 May, 1950); general charge. \*£200,000. 2 April, 1951.

**INDUSTRIAL CHEMICALS, LTD.,** London, W.C. (M., 1/12/1951). 23 October, £250 debentures, part of a series already registered. \*£5,000. 17 October, 1950.

**PHOTO-CHEMICAL CO., LTD.,** London, W.C. (M., 1/12/1951). 24 October, £300 debentures, part of a series already registered. \*Nil. 31 December, 1950.

**CHELLENHAM PLASTICS LTD.** (formerly A. S. BREWER & Co. (PLASTICS), LTD.), London, E.C. (M., 8/12/51). £2,500 debentures, to Branch Nominees, Ltd.; general charge (ranking *pari passu* with existing first debentures, dated 2 October, 1950, and 26 January, 1951, and in priority to two series of debentures). \*£6,500. 28 June, 1951.

**LEDA CHEMICALS, LTD.,** London, E.C. (M., 8/12/51). 25 October, £6,250 mortgage, to Howard Wall, Ltd.; charged on land at rear of Howard Wall, Ltd.'s factory at Eleanor Cross Road, Waltham Cross. \*£2,100. 28 December, 1950.

**METACHEMICAL PROCESSES, LTD.,** London, W. (M., 8/12/51). 24 October, £5,000 debentures; general charge. \*Nil. 10 March, 1950.

**GEORGE ROYSTON & SON, LTD.,** Barnsley, chemical engineers and lead burners. (M., 8/12/51). 15 October, resolution ratifying and confirming charge dated 29 August,

1951, securing to Barclays Bank, Ltd., all moneys due or to become due to the bank; general charge. \*£4,000. 31 December, 1950.

**SYNCHEMICALS, LTD.,** London, S.E. (M., 8/12/51). 22 October, charge, to Barclays Bank, Ltd., securing all moneys due or to become due to the bank; charged on 'Garland Hill,' St. Pauls Cray. \*Nil. 28 February, 1951.

**UNITED SULPHURIC ACID CORPORATION, LTD.,** Ipswich. (M., 8/12/51). 19 October, £3,000,000 first debenture stock secured by a Trust Deed dated 5 October, 1951, charged on the company's rights and interests, etc., in a participation agreement dated 5 September, 1951, and deeds of covenant, also a general charge.

**J. J. WADE (LONDON), LTD.,** plastic manufacturers. (M., 8/12/51). 24 October, charge, to Westminster Bank, Ltd., securing all moneys due or to become due to the bank; charged on specified property at Islington.

#### Increase of Capital

The following increases in capital have been announced:—**COMMERCIAL SOLVENTS (GREAT BRITAIN), LTD.,** from £250,000 to £300,000; **INDO-BRITISH INDUSTRIES, LTD.,** from £1,000 to £5,000; **JAMES WILKINSON & SON, LTD.,** from £25,000 to £100,000; **JOHN & JAMES WHITE, LTD.,** from £600,000 to £750,000; **INTERNATIONAL PAINTS, LTD.,** from £1,150,000 to £1,200,000.

#### New Registration

##### Ultrafine, Ltd.

Private company. (501,626). Capital £100. Manufacturers of all kinds of crushing and separating machinery and plant, consulting and mechanical engineers and general designers. Solicitors: Theodore Goddard & Co., 5 New Court, W.C.2.

Reports that Britain may try to make up her Iran oil losses from the Alberta tar sands of Canada have recently come from Ottawa. Investment by British firms in this case would involve negotiations with the Government of Alberta, not the central Federal Government.

# Publications & Announcements

THE manufacture of paint, flooring compositions, and the impregnation of textiles are some of the uses served by the polyvinyl acetate emulsions now available from Fort Dunlop's new modern plant. Of the range of these P.V.A. emulsions, two have been designed specially for the paint industry. Both form highly water-resistant films which are 'finger-dry' within an hour or two of application. One emulsion is of high stability and is capable of heavy loading to give a flat water paint of good covering power. The other is intended for use as a transparent, high gloss finishing lacquer.

\* \* \*

A NEW valve indicator which provides immediate at-a-glance information on the exact setting of a valve, thus eliminating guesswork in controlling the supply of steam, water, air, gas, oil, pulp, chemicals, etc., is the subject of a technical leaflet published by the Reiss Engineering Co., Ltd., of Dalston Gardens, Stanmore, Middlesex. This R.E.C. valve indicator, suitable for all types and sizes of globe and gate valves from  $\frac{1}{2}$  in. upwards, with rising or non-rising spindles, does not interfere with the operation of the existing handwheel, say the company, and can be applied to a valve in any position, horizontal, vertical or inclined.

\* \* \*

ONCE again a detailed technical record of fire-fighting equipment available to deal with normal and emergency flagrations anywhere in the British Isles appears in the 1952 edition of the 'Fire Protection and Accident Prevention Year Book,' just published by Benn Brothers, Ltd., Bouverie House, 154 Fleet Street, London, E.C.4, price 10s. 6d. inclusive of postage. Not only are all the public Fire Brigades listed, together with the appliances available to deal with any type of fire, but similar records covering fire-fighting units wholly maintained by industry and private sources now ready to assist in the new civil defence schemes. The YEAR BOOK also contains information about Brigades in the Commonwealth and Empire, together with legal and technical data of particular interest to all those in industry and the public services who are primarily concerned with the safety of life and property. A diary section is also included.

A BIN vibrator claimed to eliminate stoppages caused by choked hoppers and build-up of material in chutes, etc., is the subject of a leaflet published recently by the Magnetic Equipment Company of Portsmouth. 'Magco' Vibrators, claim the company, make slow-moving material flow like water and are the complete answer to the demand for increased output. Three sizes are available, and the vibrators are said to require no attention and no lubrication.

\* \* \*

LONDEX Ltd. have just issued a new publication containing information on their range of products in condensed, factual form which they believe will be very acceptable to engineers. The booklet contains details of a number of units not previously announced. It is in four sections covering relays, special apparatus, timers and fluid and gas control, but so many variations are possible, say the company, in their units that all they can do is give 'potted' data on the normal use of the more standard units.

\* \* \*

MODERN ideas in design are incorporated in the new Ford pharmaceutical vial capping machine, advance details of which have just been released by Fords (Finsbury), Ltd. The machine comprises four units, capmaking, hopper, cap applying, and sealing, which may be installed all together as a complete chain of plant, or may be employed separately where required to do particular jobs. The capmaking press will work on foil of any thickness up to .300 mm. It will run permanently at any speed up to 10,000 an hour and is fitted with a mechanical counter. The caps are fed into bins and emptied into the hopper feed which arranges them to the position required and passes them via a chute to the cap applier. The applier will work at any speed up to 6,000 an hour. It incorporates two safety checks—a mechanical ejector which throws out any vial fitted with a distorted cap, and an electronic checker which stops the machine and lights a warning on the control panel if a vial has come through without a rubber bung or without a cap. In the sealing unit, caps are spun on to the vial by means of a three-head rotary spinner. The complete plant will be displayed at the 1952 British Industries Fair.

## Next Week's Events

### MONDAY 10 DECEMBER

#### **Institution of the Rubber Industry**

Manchester: Engineers' Club, Albert Square, 6.15 p.m. J. B. Harrison (Factice Research and Development Association): 'Factice: Its Use and Functions in Rubber Technology'.

#### **Institute of Metals**

Glasgow: Institute of Engineers and Shipbuilders, 39 Elmbank Crescent, 6.30 p.m. Symposium on 'Materials Testing'.

### TUESDAY 11 DECEMBER

#### **Society of Chemical Industry**

London: Imperial College, Imperial Institute Road, South Kensington, 2.30 p.m. Agricultural Group. T. P. Dee and Dr. Rice Williams: 'Alternative Phosphatic Fertilisers'—followed by discussion.

#### **Chemical Engineering Group (SCI)**

London: Burlington House, Piccadilly, W.1, 5.30 p.m. H. Birchall: 'The Planning of Maintenance in Chemical Works'.

#### **Incorporated Plant Engineers**

Manchester: Engineers' Club, Albert Square, 7.15 p.m. G. S. Irving: 'Corrosion in Boiler Steamlines and Condensate Return Pipelines'.

### WEDNESDAY 12 DECEMBER

#### **Society of Chemical Industry**

London: Burlington House, Piccadilly, W.1, 6.15 p.m. Nutrition Panel of the Food Group. Subject: 'Sugar'; H. S. C. De Whalley: 'Its Production, Purification and By-products'; R. D. Lawrence: 'Its Place in the Dietary—Normal and Abnormal Metabolism'.

#### **Institution of Chemical Engineers**

Birmingham: Chamber of Commerce, New Street, 6.30 p.m. Graduates' and Students' Section, Midlands Centre. D. C. Freshwater (Graduate): 'The Design of Bubble-Cap Distillation Columns'.

#### **The Chemical Society**

Dublin: Trinity College, 7.45 p.m. Dr. F. L. Rose: 'Novel Cytotoxic Agents'.

#### **Iron and Steel Institute**

London: Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Symposium on 'The Corrosion of Buried Metals'. Two sessions—10 a.m. and 2.30 p.m. Chairman: Sir Charles Goodeve, director, British Iron and Steel Research Association.

#### **Institute of Metals**

London: Waldorf Hotel, Aldwych, W.C.2, 7 p.m. Joint meeting with Institute of British Foundrymen. A. P. Fenn: 'The Development of Aluminium Alloy Casting'.

### THURSDAY 13 DECEMBER

#### **The Chemical Society**

London: Burlington House, Piccadilly, W.1, 7.30 p.m. Tilden Lecture. Professor D. H. Hey: 'Some Recent Developments in the Chemistry of Free Radical Reactions in Solution'.

#### **Society of Public Analysts**

London: University College, Gower Street, W.C.1, 6.15 p.m. Biological Methods Group, annual general meeting.

#### **Pharmaceutical Society**

Manchester: Midland Hotel, 7.45 p.m. E. Pedley: 'Application of Science in the Detection of Crime' (illustrated by lantern slides).

#### **Chadwick Public Lectures**

London: St. Mary's Hospital Medical School, Norfolk Place, Praed Street, Paddington, W.2, 4.30 p.m. Malcolm Morris Memorial Lecture. Professor C. Cruikshank: 'The Epidemiology of Some Skin Infections'.

#### **The Royal Society**

London: Burlington House, Piccadilly, W.1, 4.30 p.m. C. H. Andrews: 'The Place of Viruses in Nature'.

### FRIDAY 14 DECEMBER

#### **Society of Chemical Industry**

London: King's College, Strand, W.C.2, 7.30 p.m. Fine Chemicals Group. B. H. Turpin (Quickfit & Quartz, Ltd.): 'Glass Plant in Industry and Research,' followed by discussion. By invitation of Mrs. B. Watkins, director of chemical engineering studies, the chemical engineering department of the college, will be on view from 6.30 p.m., prior to the meeting.

#### **Institution of Chemical Engineers**

Newcastle-on-Tyne: Stephenson Building, Claremount Road, 6.15 p.m. Graduates' and Students' Section, North East Centre. P. M. Shaw (Graduate): Plant Management in Chemical Works'.

#### **The Chemical Society**

Belfast: Queen's University, 7.15 p.m. Joint meeting with the RIC and SCI. Dr. F. N. Woodward: 'The Industrial Utilisation of Agricultural By-Products'.

**The Institute of Physics**

Manchester: University, 7 p.m. Dr. J. Weston (Building Research Station): 'Full-scale Heating Research'.

**Manchester Statistical Society**

Manchester: Albert Hall, Peter Street, 6.45 p.m. Industrial Study Group. D. H. Ward: 'Statistical Tests in the Comparison of Laboratories'.

**Oil and Colour Chemists' Association**

Manchester: Grand Hotel, 6.30 p.m. Brains Trust.

**Textile Institute**

Manchester: 16 St. Mary's Parsonage, 1 p.m. J. W. Illingworth (Textile Research Division, Dunlop Rubber Co., Ltd.): 'Textiles in the Rubber Industry'.

**The Royal Institution**

London: 21 Albemarle Street, W.1, 9 p.m. Professor E. N. da C. Andrade (Fulmerian Professor of Chemistry; director in the Royal Institution): 'The Mechanics of Metal Crystals'.

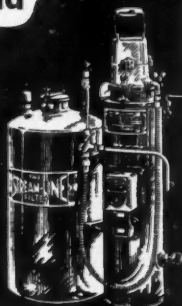
**The Institute of Physics**

London: Institute House, 47 Belgrave Square, S.W.1, 6.30 p.m. R. W. Kahn, E. B. Bell and J. C. E. Button: 'Applications of Traces in Industrial Research'.

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### **FURTHER ANNOUNCEMENT**

(See Advertisement on Page xiii)

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**CHEMICAL ENGINEERS** are required at various levels in the Design and Development Department of a well-known Chemical Manufacturing Company in South Lancashire. Starting salary will depend upon qualifications and experience, but will not be less than £600 per annum. The Company encourages effort and enterprise, and promotions are strictly by merit and ability. Write, stating age, qualifications and experience, **BOX NO. C.A. 3071, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.**

**CONTRACTS MECHANICAL ENGINEERS** required to deal with the organisation and planning of Refinery or Chemical Plant through all stages of mechanical design. University, Engineering or Chemistry Degree preferred. Duties to be in London, with travel at intervals to sites. Age limit, 30-50. Salary according to experience and qualifications. Superannuation Scheme. Apply **BOX NO. 46, c/o BROWNS, 37, TOTHILL STREET, S.W.1.**

**SALESMAN** required for Industrial Chemical Department of old-established City Merchant House. Age preferably 25-35. Good salary, bonus, Pension Scheme. First-class qualifications necessary. **BOX NO. C.A. 3073, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.**

**THE DIVISION OF ATOMIC ENERGY (PRODUCTION)** invites applications for the post of **HEALTH PHYSICS AND SAFETY GROUP MANAGER** at Windscale Works, Sellafield, Cumberland. The Group is responsible for the measurement and control of exposures to radio-active and allied chemo-toxic materials, within the factory and in the surrounding district, and for all the other works' safety services.

Candidates should have either an Honours Degree in Physics or Chemistry, Associateship of the Royal Institute of Chemistry or the Institute of Physics or equivalent qualifications. Experience with electronic or radiation measuring equipment and with safety control in physical or chemical operations would be an advantage.

Salary will be assessed according to qualifications and experience within the range £1,177-£1,370 per annum. There is a voluntary superannuation scheme. Applications to **MINISTRY OF SUPPLY, D.A.En.(P), Risley, Nr. Warrington, Lancs.,** quoting reference 269. Rs. 9586 20/11/51.

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**2 FANS** by Benno Schilde. Capacity, 29,500M<sup>3</sup>/hour (1,040,000 cu. ft. per hour), 1,000 mm. (40 in.) water column, for gas 220 deg. C. Approximately 150kW (200 h.p.) required to drive.

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Two End **RUNNER MILLS** with porcelain pans.  
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**BAND CONVEYOR**, 50 ft. long 40 in. wide, steel frame motorised, for boxes, cases, bags, etc.

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1½, 2½ and 3½ size belt-driven **DISINTEGRATORS** by Christy & Norris or Harrison Carter.

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Four **ROTARY BOWL MIXERS**, 5 ft. diam., cast iron built, inclined agitators, by Baker Perkins.

Two **FILTER PRESSES**, fitted recessed C.I. plates, 40 in square, 2½ in. thick, centre fed, to make 11 cakes per Press.

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Large unjacketed **WERNER MIXER**, belt and gear driven, hand tipping, double "Z" arms, pans 53 in by 45 in by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER or INCORPORATOR**. Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the top of the tipping screw.

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**TWO** **M.S. AUTOCLAVES**, 650 gallon and 200 gallon, with hinged lids and swing bolts. Suitable for 50 lb. internal pressure.

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Horizontal and Vertical **MIXERS** in all sizes made to requirements.

Numerous sizes all bronze, brass tube **CONDENSERS** and **HEAT EXCHANGERS** in stock, from 20 to 70 sq. ft. surface areas.

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One 30' x 7' 0" diam.

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"U" **TROUGH MIXERS**, 6 ft. by 2 ft. by 2 ft. deep, 400/350.

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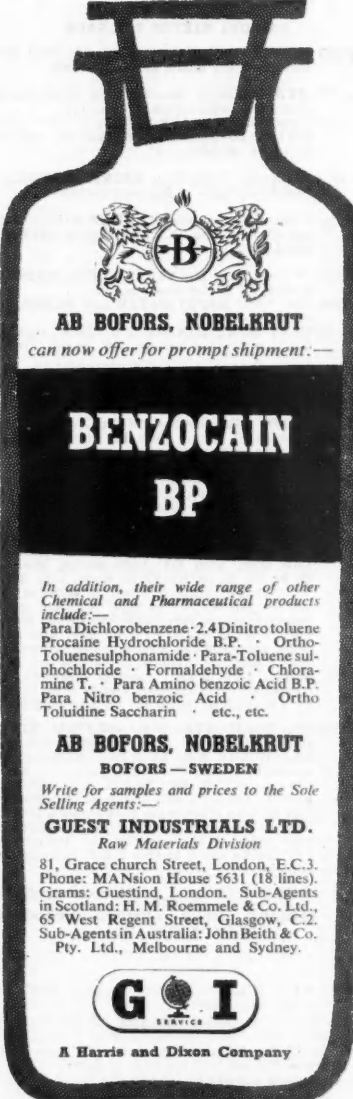
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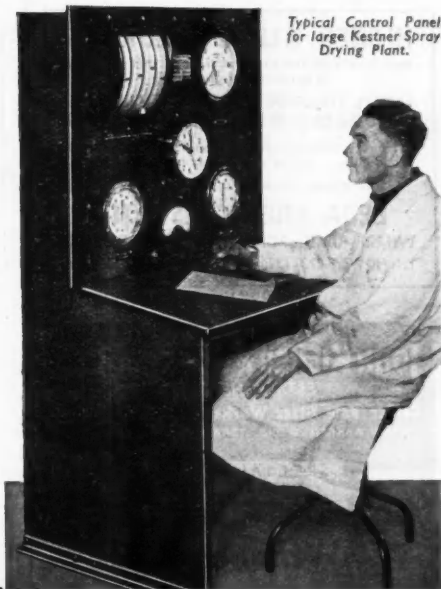
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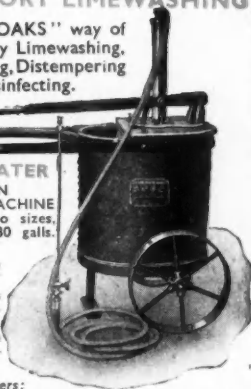
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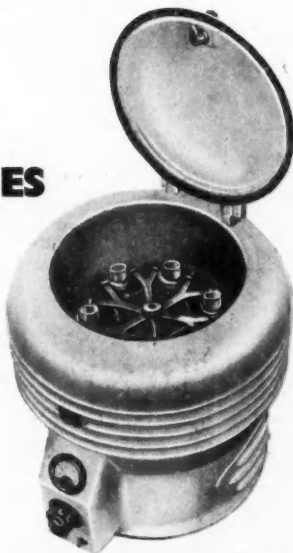
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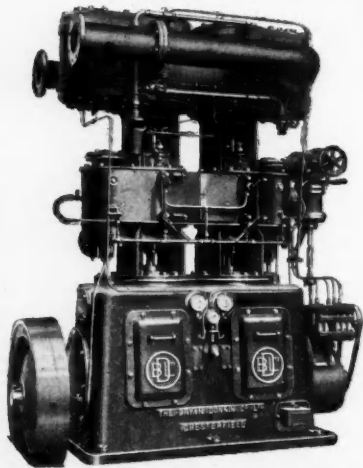
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